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E. T. CANDEE, *Acting Editor*

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THE MONTHLY REVIEW

THE COVER

Cover illustration is furnished through the courtesy of The Meaker Co., designer and manufacturer of equipment shown. Illustration is a large round wire galvanizing unit which uses approximately 75,000 amperes of current turning out large tonnage of steel wire of all gauges.

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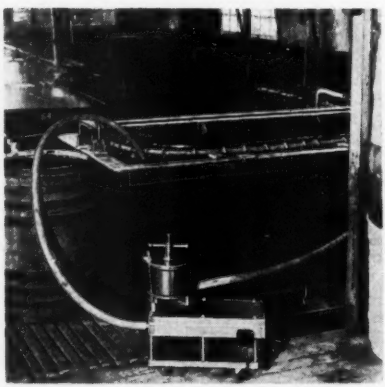

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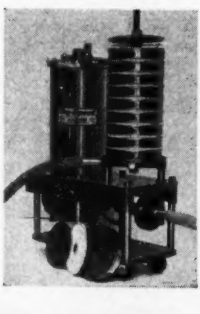

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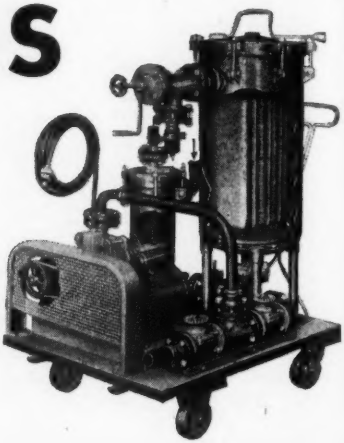

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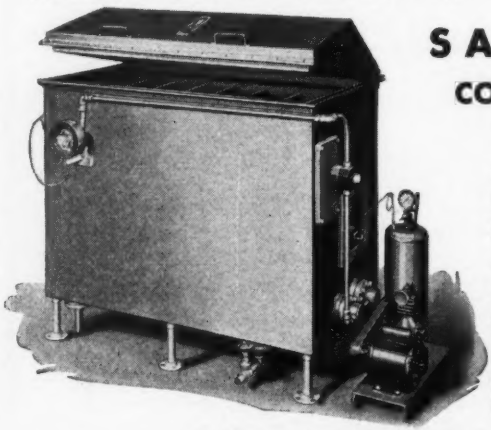

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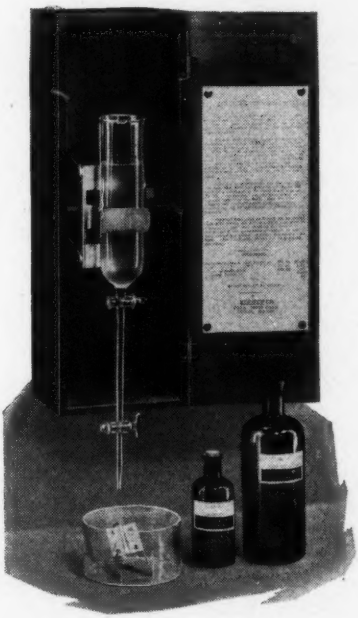

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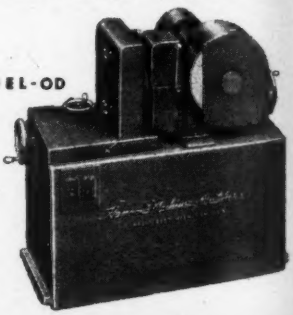

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The Fundamentals of Electrochemistry and Electrodeposition

Part XVI. Concentration Polarization and the Diffusion Layer

By SAMUEL GLASSTONE, D.Sc., Ph.D.
Professor of Chemistry,
The University of Oklahoma, Norman, Okla.

CONCENTRATION POLARIZATION

AN important form of polarization results from concentration changes at the anode and cathode; it is consequently known as "concentration polarization". It plays a significant part in many electroplating processes; it is, in fact, concentration polarization that frequently determines the maximum current density (C.D.) at which a particular metal can be deposited from a given solution with high efficiency. All forms of polarization are fundamentally due to the slowness of some stage in the complex, and not completely understood, processes occurring at the electrode. The type of polariaztion known as over-voltage, referred to in Parts XIV and XV of this series of articles, is probably due to some hindrance in the discharge of the ions, but concentration polarization is to be ascribed to the slowness of diffusion. If ionic diffusion processes were extremely rapid, concentration polarization would practically cease to exist, and there would be almost no limit to the C.D. which could be employed in electroplating with 100 per cent efficiency. However, this is unfortunately not the case; it is, therefore, of interest to consider further the consequences of diffusion being relatively slow and how it leads to the phenomenon known as concentration polarization.

DIFFUSION OF IONS

In order to clarify the discussion it will be convenient to consider a typical example of metal deposition, although the arguments are applic-

able to all similar processes. Suppose we have a solution of copper sulphate from which the metal copper is being plated out as a result of the passage of a current of electricity. The copper ions in the solution near the cathode will have their positive charges neutralized and will then separate as copper atoms. This means that there will be a decrease in the concentration of copper ions in the immediate vicinity of the cathode. However, this deficiency can be made up in two ways: in the first place the current itself will carry a certain amount of copper ions to the cathode, and in the second place the operation of natural diffusion will bring in ions from the body of the solution. The extent to which the copper ions are carried by the current depends on the number and nature of the other ions present in the solution. As a general rule plating baths contain sufficient acid or other electrolyte for a small quantity only of the ions discharged at the cathode to be carried by the current. The replacement of the copper ions removed at the cathode is thus dependent almost entirely on diffusion.

CONCENTRATION CHANGES NEAR CATHODE

In the course of electroplating, therefore, ions are removed by being deposited, and they are replaced by diffusion from the bulk of the electrolyte. The rate of diffusion is such, however, that it can never quite keep pace with the ions that are removed; the result is, therefore, that the concentration of ions in the immediate vicinity of the cathode will be less than in the remainder of the solution. According to the equation for the discharge potentials of cations, given in Part XIII, it will be seen that a decrease of concentration makes the potential more negative. The potential of a cathode at which metal is being deposited is thus greater (negatively) than that of a stationary, or reversible, electrode in the same solution, because of the reduction in ionic concentration at the cathode while the current is passing. It is this displacement of the potential, due to concentration changes resulting from the slowness of diffusion, that is called "concentration polarization". As long as the C.D. is small, the extent of concentration polarization will be insignificant, but as the current is increased and the rate of removal of the ions by discharge becomes great, the magnitude of the concentration polarization increases. The conditions leading to concentration polarization are, of course, operative at all cathodes where ions are being discharged. They also exist to some extent at anodes, because the concentration of ions is being increased as

a result of the anode going into solution. As far as electroplaters are concerned, however, concentration polarization at the anode does not have such great significance as that at the cathode.

THE DIFFUSION LAYER

Since the concentration of ions near a cathode at which metal is being deposited differs from that in the bulk of electrolyte, there must obviously be some kind of intermediate or transition layer in which the concentration varies. On the solution side of this layer the ionic concentration will be the same as in the body of the solution, while on the cathode side it will be much lower, the difference depending on the C.D. at which the ions are being discharged. It is across this intermediate layer that diffusion occurs from the bulk of the solution to the electrode, and so it has been called the "diffusion layer". The layer at the surface of a cathode is frequently referred to as the "cathode film", but this implies the same thing as is called here the diffusion layer. The properties of this layer have been studied in a number of ways and its existence may be regarded as definitely established. The presence of the layer can often be proved by direct observation. For example, if a solution of a copper or a nickel salt is being electrolyzed at a fairly high C.D., the presence of the cathode layer may be detected by the upward streaming of the less concentrated solution near the electrode. It may be noted, by the way, that the upward flow of electrolyte is often the cause of vertical streaks on the metal plated at the cathode.

THE LIMITING C.D.

One method of studying the properties of the diffusion layer is to increase the C.D. at the cathode and to observe the corresponding potential of the electrode. The latter will be found to increase steadily, but slowly, at first as the concentration polarization increases, but at a certain C.D. the potential suddenly rises to a much higher value. If the current efficiency for metal, e.g., copper, deposition is measured at the same time, it will be found that it remains constant at first at about 100 per cent, but when the potential rises rapidly the efficiency drops off. The explanation of this behavior is that as the C.D. is increased the rate at which the ions

are removed from the cathode layer is increased, and these must be replaced by diffusion. However, there is a definite limit to the rate of diffusion, depending on the concentration of the bulk of the solution, and when the rate of discharge of ions by the current equals the maximum rate of diffusion, the metal is being deposited at the maximum rate under the given conditions. If the current is increased still further, some other ion, generally hydrogen ion, must be discharged in addition to the metal ion, and this causes the potential to rise rapidly. Since part of the current is now being used to liberate hydrogen, the current efficiency for metal deposition must fall below 100 per cent. On the assumption that the maximum C.D. for 100 per cent efficiency, often referred to as the "limiting C.D.", is equivalent to the maximum rate of diffusion of ions to the cathode, it is possible to calculate the effective, limiting (maximum) thickness of the diffusion layer. Many experiments indicate that in an unstirred aqueous solution at ordinary temperatures it has a thickness of about 0.05 cm. By means of this figure it is frequently possible to calculate the approximate maximum C.D. for deposition of a metal with 100 per cent efficiency. This maximum C.D. can be increased in three ways: first, by increasing the concentration of the solution; second, by agitation; and third, by raising the temperature. These factors all increase the maximum rate of diffusion of ions to the electrode and so raise the limiting C.D.

ANALYSIS OF THE CATHODE LAYER

A new method for studying the cathode layer, which has great possibilities, is to cool the cathode suddenly so that a film of solution is frozen to it. Thin layers of this solid are then shaved off in a lathe; they are allowed to melt and are then analyzed. The outermost shavings have the same concentration as the bulk of the electrolyte, but as the electrode is approached the measured concentrations are observed to fall off steadily. The concentration in the thin film in actual contact with the cathode is found to have a greatly reduced concentration of the ions being deposited. The few experiments of this type that have been made so far confirm the existence of the diffusion layer, but they indicate that it has about half the thickness mentioned above. This relatively minor discrepancy may be due to the fact that the limiting C.D. method gives the maximum thickness of the layer under limiting conditions.

How to Get What You Expect From Power Washing Now and After the War*

KENNETH P. BELLINGER
Chemical Corp.

WASHING machines have been in use for many years, and to many people the mention of a washing machine still conjures up a small belt or rotary machine possibly of one or two stages with perhaps a spray system or even a slosh type washing action very infrequently followed by a dryer.

Belt type washers are still used in many installations particularly where production schedules are heavy, but there have been many refinements. Belt washers usually carry the heavy productions primarily because one man can handle the loading and another the unloading. Belts are of many types of construction such as mesh, bars, and rods depending on whether work is to be handled in baskets, laid on the belt or in some cases pinned or racked to the belt or chain.

Because of the belt construction, the machine must be operated in a straight line and for this reason, if the series of operations is at all complex, the machine may be 40 or 50 feet long. This might be a disadvantage in older plants, where work processes are split up on several floors.

This type of machine is widely used by the bearing industry and lends itself to their particular requirements. An example would be:

Wash in alkali
Rinse
Soluble oil slush—to prevent rusting
Dry
Mineral spirits, oil slush for anti-rusting purposes
Cold blast blow-off for immediate inspection.

*Presented at the Dec. 14, 1942, meeting of Hartford Branch A.E.S.

Another common type washer is the overhead conveyor or trolley type. An advantage of this group is the fact that if several operations are to be carried on, such as wash, rinse, bonderize, rinse, chromic acid and dry, the machine can be doubled back on itself and take up less space. Another advantage is the fact that racking and unracking can be carried on in one place.

Large parts such as auto body parts, refrigerators, cabinets, etc., lend themselves to this type machine as well as racked work for plating.

A washer recently used with considerable success is the return tray type. Here baskets of work are placed on trays which index up thru a wash section and one or more rinse sections and follow down into the lower section on the return, which they are dried. This machine lends itself to work that is racked in baskets, and the baskets are often used in place of tote pans. Advantages of this machine are compactness, loading and unloading at one station, and a comparatively large capacity.

Another design allowing loading and unloading at one point is the rotary table type. In this machine various washing and drying operations are performed in the circumference of a circle. An advantage of this design is its compactness and large production capacity. Machines are built with capacities for operation by one or two men.

Small machines of this type are made in which only one operation is performed. The loading can be either continuous or intermittent depending on requirements and design of machine.

Small unit tanks are sometimes used, fitted with sprays and a motor-driven pump in which a basket or rack of work is cleaned by suspension in the tank.

Another design is the rotary drum washer. This machine consists of a long, horizontal cylinder fitted on the inside with a spiral helix.

There are many ways of performing the washing operation in one of these machines. In every case a rumbling action of the parts takes place as they are carried thru the machine. Cleaner, rinse, etc., may be introduced in the drum by a spray supplied by a motor-driven pump in which rumbling of parts helps to give complete coverage, or by a scoop which dips solution into the cylinder, or by means of a bell-shaped drum which cleans by immersion. The latter method is resorted to for pickling and has found wide application in treatment of small calibre cases or cups

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CHROMIUM PLATING is widely used to extend the life of ordnance parts and machine tool equipment, to salvage worn or rejected parts and tools, and to save countless man-hours in the production of vital war materials.

THE UNICHROME* ALKALINE COPPER PLATING PROCESS makes possible ductile, fine-grained deposits which are utilized wherever they are found to be essential for the fabrication of parts and where they make possible savings of larger weights of critical metals.

THE UNICHROME* ALKALINE STRIPPING BATH is of great assistance in meeting the problem of removing certain metals such as copper, chromium and zinc from steel. It is exceedingly fast—coatings up to .001" can be removed in 10 minutes or less. The bath is a mildly alkaline, non-toxic solution and does *not* etch the steel base metal.

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UNICHROME* "QUICK DRY" STOP-OFF LACQUER 322—An adherent, very fast drying lacquer used in chromium, cyanide copper, and other plating solutions for stopping off areas which are not to be plated. It also stands up in hot, electrolytic alkaline cleaners.

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UNICHROME* LACQUER B-124—A baking synthetic which gives a durable, porcelain-like coating resistant to sulfides, alcohols, beverages and salt solutions. Protects metal surfaces against the corrosive action of moist conditions even at elevated temperatures.

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TO CONSERVE MATERIALS—United Chromium processes, production materials and technical assistance save time and avoid waste of valuable metals and solutions.

TO CONTRACT WORK TO COMPETENT SHOPS—United Chromium is prepared to recommend companies who through experience, equipment, personnel and the supervisory counsel of U. C. Engineers, are ideally suited to handle your type of work.

Whether in connection with Chromium Plating, the Unichrome Alkaline Copper Processes, or our production materials, the United Chromium organization is devoting its vast experience and engineering facilities to the problems of hundreds of licensees in meeting today's plating requirements. An inquiry outlining your problem will bring prompt and specific recommendations on how the U. C. processes and advisory service can help you.

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after annealing. In every case the solution drains back into the tank thru holes in the cylinder. These machines can be built in a straight line and can be entirely automatic being fed by belts and dumped on conveyors.

They may be fed at one end, a series of operations performed, the parts dropped into another drum that returns them to the same operator, more operations being performed on the return.

These machines are ideal where production lends itself to washing quantity lots of the same part. Consideration of the part to be washed is mandatory for not all parts will carry thru a machine of this type.

The discussion now turns to the type of cleaners to be used.

Alkali cleaners come first on the list because they are inexpensive, can give water break free work and because they work at such low concentrations. In many cases they give work unusually free from carbon smuts. In pressure spray washing, only alkalies can be used, as soaps and wetting agents cause excess foaming and have not been found necessary. Silicates seem to give the best results because of their unusual emulsifying and superior rinsing characteristics.

Where concentrations as low as one-half ounce per gallon are used it is considered best to drain the machine at frequent intervals to keep the dirt load from building up.

Alkali cleaners can give such clean work that rusting is sometimes a problem if they are followed by a hot rinse. For this reason, anti-rusting agents are sometimes used in the rinse tanks. These may be soluble oils, chromates, alkalies, etc.

Where an immediate plating operation is contemplated, parts are not dried and a cold rinse is used. In such a case rusting is not a problem. Cold rinses seem to be best for smut removal problems.

Emulsion cleaners have found favor where parts must be stored and no rusting is allowable. They are effective in removing oil and chips and leave an invisible oil film on the work when dried, which can be painted over. They are also ideal where painted parts are to be washed and the paint film must be left unattacked.

In some cases machines are operated with safety solvents or light oil. A good example of the latter is the washing of assembled ball bearings where the oil is constantly filtered.

It might be well to reconsider the washer itself from a design and construction standpoint.

This has probably given the washing machine its biggest stumbling block. A washing machine can be as simple or as complex, can cost as little or as much as the user wishes to pay and this is where the trouble starts.

Good washing machine design is more than being able to fabricate metal. It is the accumulation of years of experience interpreted in the customers needs.

John Doe decides to buy a washer. He has a certain problem to do. If he has never bought a washer before and therefor has no experience in this field, he probably contacts several builders of washing machines, gives them his problems and ask for quotations. In due course of time he gets several quotations. They may all be in line, in which case he believes he is on the right track or one may cost double another. This should make him suspicious.

Maybe John Doe is a shrewd man looking for a bargain in which case he buys the cheapest machine and awaits delivery. He gets the machine but he may also be cursing washing machines in general when it has been in operation a short time.

Following are some of the points John Doe should have checked:

(1) Is the machine structurally sound? Is it made of durable stock, heavy enough for the job today and ten years from today?

(2) Are the pumps and accessories of high quality?

(3) Is he getting a fully-equipped machine ready to make service connections or a stripped-model?

(4) From checking with other machines of the same design in the field, can he expect good results?

> A 5-horse power pump on a pressure spray may deliver 20-lb. pressure at the nozzle or 40-lb. pressure depending on the nozzle design. Does the manufacturer have a good nozzle design or does he drill a hole in the pipe? Spray cleaning of metal depends on the impingement of the spray on all parts of the object, and a poorly designed spray is the difference between good results and no results in many cases.

(5) Are the sprays accessible for cleaning?

(6) Are there screens over the pumps to keep out dirt?

(7) Have the tanks been built to facilitate cleaning? They may have to be cleaned daily if the dirt load is heavy.

(8) Does the designer make space allowance between washing sections for no drag over and properly baffle the sections, or does he put one section adjacent to another and hang curtains, which, when they get dirty, will stain the work and when used a while will wear out?

(9) If draining and cleaning of tanks must be on a shift basis are the drain and fill pipes large enough to do this in a short period of time and has he provided an adequate heat exchanger with the steam pressure on hand to heat the tank up quickly?

(10) Are the exhaust sections placed so that the drip falls on clean work? It has been done!

(11) If the machine calls for a dryer, is it adequate to dry the work? Is it designed to dry the work without spotting it, if that is demanded? Is the dryer insulated properly?

(12) Has the designer investigated your individual problem and built a machine for your requirement or did you get a so-called all-purpose machine from stock?

(13) Does the manufacturer of the machine guarantee his product, and if so, to what extent?

(14) Lastly, when he recommended a certain sequence of operations, did you try to make him believe you could get along with half as many?

All the above items should have your serious consideration. In buying to cut corners and save expense, you alone will be the loser.

These points should be kept in mind because the man interested in the machine may often times be a finisher who does not buy machinery every day and if he is not on his toes, someone may make the decision for him whose main thought is the first cost of the machine.

From the foregoing statements it might seem that the manufacturer may not be able to afford the machine. A machine should not be considered for a specific job, unless it can do it better than the present operation or unless it can pay for itself in a comparatively short time thru a saving in labor, chemicals or time, or a combination of all these.

At the present time, power washers are being used primarily for washing machined parts or shell components. Neither one of these jobs is considered very difficult.

Shortly before the war, a new field for washers was opened up—the washing of buffed work before plating. A good example of this was removal of buffing compounds from brass. This has alays been a major problem to platers.

A few plants in this vicinity were using machines and getting cleaner and more uniform work in one power-washing operation than in a former soaking, swabbing and an electro-cleaning operation. It is not difficult to surmise the labor and material savings involved.

An operation successfully developed as a result of the war has been the use of acid in pressure spray pickling. Many machines are in operation today spray pickling 10% (by volume) sulphuric acid on large brass shell cases to remove the oxide after annealing.

Preliminary work done spray pickling of steel forging and high carbon steels seems to indicate that an entirely new field is being opened up and is worthy of your investigation if you have any similar problems.

The pickling time is cut to one-third or one-fourth, the parts are much cleaner. They show little hydrogen embrittlement and after a cold rinse, and drying operations, some steels have resisted rusting to a remarkable degree.

An explanation for this may be that the acid spray is saturated with air, and thence oxygen, which immediately converts any atomic or nascent hydrogen to molecular hydrogen. Also the spray action has a brushing effect that removes the hydrogen as quickly as it is formed preventing absorption as well as removing loosely-adhering scale deposits as in the case of forgings.

All of us today think of full automatic plating in terms of electrolytic cleaning and dip pickling. These two developments indicate that the automatic of the future may contain a spray washer and a spray pickler, using much lower concentrations of chemicals and coming ever closer to the surface every plater constantly aspires to—a chemically clean one.

*Presented at the Dec. 14, 1942, meeting of Hartford Branch of A.E.S.

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Surface Finishes for Aluminum and Alloys*

By CHARLES C. CAHN
and DR. EDWARD ENGEL
Colonial Alloys Company

THE subject matter of this paper deals primarily with the surface treatment of aluminum. By aluminum, is meant pure aluminum and alloys of aluminum.

The word "aluminum", however, cannot be mentioned without referring to its present and future importance in the world of materials.

To quote some statistical data about this rustproof white metal it should be noted that the normal past civilian requirements were about 300 million pounds yearly.

The current production contemplated to be achieved soon annually is 2 billion, one hundred million pounds. In dollar volume it will exceed total copper production in the United States and will begin to approximate total steel production.

Weighing about ⅔ less than copper, brass, or steel, at the anticipated lower production costs and selling prices, aluminum will cost much less than copper or brass, and bids well to compete with steel (area for area).

Obvious advantages in light weight, freedom from rust, lower labor and transportation costs, will obviously convert huge copper, brass and steel users to aluminum for innumerable applications.

Because thousands of manufacturers during war times will have learned to work, machine and furnish aluminum, there will be no lag for educational work in this metal, immediately following cessation of hostilities.

However, the object of this paper, while it will have its reflections in peace times, is intended for now. It is its purpose therefore to acquaint

*Read at January New Haven Branch meeting.

you with methods and materials to relieve present congestions in the field of surface finishes for aluminum.

Most of the aluminum produced today is allocated to aircraft construction. Nearly all of this material is specified to be surface-treated for protection from corrosion, abrasion or for dielectric or insulating purposes.

Of the finishes used and specified, the one commonly known as anodizing is of prime importance, since most of the aluminum now used is treated by this method. This, in effect, is plating with oxygen, wherein the aluminum is the anode.

Of importance also are the electroplating of aluminum, and its *chemical* oxidation. All of these processes will be taken up here, and where time permits, actual demonstrations will be made.

It is to be noted that aluminum is a very active metal, i.e. it stands high in the electrmotive series and is therefore relatively unstable, as compared to copper or steel. Aluminum, however, has a strong affinity for oxygen and on exposure to air or other oxygen containing media, it combines with oxygen and forms aluminum oxide. This is a rather stable material and were it not for this oxide the metal would have little corrosion resistance value.

On the other hand, it is this ever present oxide, which is one of the main reasons why it has been difficult to electroplate, paint or solder aluminum satisfactorily.

The first subject then, that will be taken up will be the electroplating of aluminum.

ELECTROPLATING OF ALUMINUM AND ITS ALLOYS

As stated before, aluminum is a very active metal and its position in the electromotive series indicates that whatever metal it would be plated with, would tend to corrode the aluminum, galvanically.

Also the ever present aluminum oxide was a barrier between the aluminum and the plate, resulting in poor adhesion and unsatisfactory plating.

Much work has been done to overcome these problems, but for the greater part, up until recently, little has been done that could be considered commercially practical.

One researcher turned an obstacle into an advantage. Instead of remov-

ing the oxide coat, he built it up by anodizing, then modified the anodized coat chemically and proceeded to plate thereon. This method has its advantages, but requires an anodizing plant and a rather long time cycle.

Other methods included immersion deposits of other metals on the aluminum, followed by plating over these deposits, but these, for the most part, had poor adhesion, and could not very well stand bending, buffing or thermal changes.

The principle of the method, which is about to be described, is explained by a *simultaneous action,* in which the oxide coat is removed and at the same time an *adherent* zinc alloy is deposited on the aluminum.

Zinc has been selected because it has been shown in numerous papers that it is protective to aluminum, even though it is more noble. The reason for this is that it is never actually coupled with aluminum as such, but with aluminum oxide which is more noble than zinc, thereby causing the zinc to have a sacrificial action toward the aluminum, instead of the aluminum toward the zinc.

In this process, known as "Preplate" a solution is used as a dip, non electrolytically, at room temperature. The aluminum is prepartorily degreased and pickled, then placed into the dipping solution for about a minute and rinsed. It is now ready for plating. While alkaline or cyanide baths are recommended as the initial plate, nickel or other plates can also be used.

This dip or "Preplate" solution is used for most any aluminum alloy or assembly of alloys.

Cleaning for most of the aluminum alloys follow the same alkaline-acid cycle except certain alloys which need slight changes in cleaning chemicals.

The "Preplate" solution is alkaline and can be stored in and used from a steel tank. It needs little or no attention and has a long life.

Aluminum, thus plated, can be bent at short radii, will stand buffing, and will not peel, crack or blister with thermal changes. It can also be soldered, using the plate as the soldering anchor.

Some of the applications for plated aluminum during the war period are:

1. Silver plated aluminum—used for radio high frequency reception, saving the weight of formerly used copper, brass or plated steel (for aircraft).

2. Cadmium plated aluminum for aircraft parts for subsequent soldering.

3. Brass plated aluminum for aircraft parts for adhesion to rubber.

4. Hard chrome plated aluminum for aircraft for cyclinders, pistons, propellers and other parts.

Thus the simplicity of the above process, makes it possible for any plating shop to adopt it without additional equipment or trained personnel.

It goes without saying how tremendous the application of plated aluminum will be after the war. Those having gathered wartime experience with it will obviously be in a better position to carry on into the great post war demands.

HIGH SPEED, LOW COST ANODIZING OF ALUMINUM

Anodizing of aluminum is actually electroplating. The deposit instead of being a metal, is oxygen. It is possible to efficiently deposit oxygen on aluminum mainly because the affinity between the two is so great. There are three general types of oxide coats. The first is the ever present air oxide, the second is the chemically formed oxide and the third the electrochemical oxide.

1. AIR OXIDE—The affinity of aluminum for oxygen is the cause of the persistent air-coat of aluminum oxide that is always present on the metal when in contact with the air (or with water for that matter). This type of coat, however, is loosely held and can be taken off by rubbing or with cleaning compounds.

2. CHEMICAL OXIDE—Another method of depositing aluminum oxide on aluminum is by chemical immersion in certain solutions, at elevated temperatures. This method coats the aluminum with a thicker, harder and more tenacious oxide than the air made coat. This is often used as a paint base, or for corrosion resistance, but cannot be considered hard or thick enough to withstand any amount of abrasion.

3. ELECTRO-CHEMICAL OXIDE — Anodizing electrically, is the means to drive the combination of aluminum and oxygen together to form a hard, smooth tenacious coat of aluminum oxide, which has the properties of a paint base, corrosion resistance, abrasion resistance, coloring base and a good insulator.

Several methods of anodizing have been in common use, using as electrolytes, aequeous solutions of oxalic, or chromic or sulfuric acid. There have been other electrolytes and methods used, but this paper shall confine itself to those indicated.

TYPES OF BATHS

1. The oxalic acid method of anodizing has for the most part been abandoned in this country and the two types of present interest, especially during this war, are the chromic acid and sulfuric acid types.

2. Chromic acid anodizing is slow, requires close thermal control and is applicable only to certain alloys of aluminum. It is also used where the sulfuric acid type would not be permitted (government specs.) in articles that have recesses or crevices, where the sulfuric acid might remain and cause corrosion. Its main use is for large surface areas such as airplane wing sections.

3. Sulfuric acid type of anodizing is in general use today and is the fastest method of those considered above.

D.C. OR A.C. (CURRENT)—All of the above methods (except oxalic acid) use direct current which requires a generator or rectifier and other complementary equipment.

It is with this picture in mind of the commercially used methods of anodizing that the story of "Electrodizing" or high speed anodizing is presented.

It is not the purpose of this process to replace other processes now in use but merely to supplement them. It is apparent, however, in many parts of the country, that there are bottlenecks in anodizing.

There are two general types of anodizing that carry government specification numbers. One is of the chromic acid base type and the other of the sulfuric acid base type.

"Electrodizing" the process about to be described is of the sulfuric acid base type, but with such additions and modications as to make it outstanding in efficiency, speed, flexibility and economy.

During this war situation it is especially important to (a) those who must increase their present anodizing facilities, (b) those who have enough anodizing contract-work to install an anodizing process and to job anodizers to take care of the great volume of work now taxing the facilities of present anodizing jobbers.

The *flexibility* of the process is illustrated by (a) it can be operated from alternating or direct current, (b) the thermal range is wide, eliminating the use of refrigerating equipment, (c) its installation is fast and simple.

The *efficiency* of the process is evident because of (a) the high current densities possible without burning the work, (b) the speed of the cycle and (c) the greater quantity of work that can be put through a given sized tank and (d) the simplicity of solution control.

Where direct current equipment is already available for the purpose, the "Electrodizing" bath could be operated with direct current.

Where this equipment is not on hand, an alternating current set-up is recommended because of

(A) the lower cost of equipment.

(B) the relative ease of obtaining equipment (a transformer is used instead of a motor generator or rectifier).

(C) more work can be put through the bath in a given time.

An alternating current Electrodizing set up consists generally of:

1. A lead lined or corrosion resistant electrolyte tank—with proper water rinse tanks.

2. A transformer with secondary voltage of from 25 to 40 volts, of proper amperage capacity.

3. A sealing tank, for the purpose of sealing the anodized coat.

4. If specifications call for colors, tanks for the purpose are needed.

The electrolyte solution is cooled by a simple method and does not require refrigeration control.

Initial and maintenance costs of a transformer for alternating current tend to be much lower than the motor generator or rectifier needed for direct current. Also much less strategic metal and materials are needed to build it.

Current densities have been run up to 48 amp per sq. foot against the conventional 12 amp for direct current.

The "Electrodizing" method of anodizing therefore has many advantages. Anodizing by this process is acceptable under Army, Navy and Air Corps specifications number AN-QQ-A-696A.

A. C. ALKALINE HIGH SPEED ANODIZING

As equally important as is this method of sulfuric acid anodizing, is A.C. method of Alkaline Anodizing.

The use of this electrolyte is an excellent alternate for chromic acid anodizing. Employing A.C. it requires a low cost transformer in place of expensive difficult-to-produce D.C. equipment.

The oxide coat deposited is not as hard as the chromic acid coat but is sufficiently hard to be satisfactory.

The speed of oxide coating is approximately 3 times greater, more work is permitted in the bath, and greater production is possible in a given time.

The tank and cooling coils can be made of ordinary steel and much more efficient cooling and agitation arrangements can be devised because of this alkaline bath.

The oxide coat is colorless and of excellent appearances and quality.

The possibility of corrosion by trapped electrolyte in crevices and recesses is eliminated since the nitric acid dip, following the processing, neutralizes all excess salts and is itself non-corrosive to aluminum.

It is of importance to mention that the three processes described above (1) Electroplating aluminum, (2) A.C. Acid Anodizing and (3) A.C. Alkaline Anodizing are very timely at this period due to anodizing bottlenecks and the need for better finished aluminum products.

Plating Aluminum

By MR. R. F. YATES
Krome-Alume, Inc.

PRIOR to the appearance of the Krome-Alume process for plating aluminum which has now been rendering commercial service for the past seven years, would-be platers of the metal and its alloys struggled to eliminate the ever present film of oxide which is quickly formed on fresh aluminum surfaces at ordinary temperatures. While this film is extremely thin its nature was such as to present an adherent deposition of the large majority of the palatable metals. Aside from this aluminum is also a rather passive metal and even with the total elimination of the oxide film it presented plating with the total elimination of the oxide film it presented plating properties that stubbornly interfered with efforts to produce commercially acceptable adhesion.

Early efforts to plate the metal and its alloys usually involved some form of etching and subsequent heat treatment of nickel deposits have brought about increased adhesion. The etching of the surface of the metal not only destroyed surface smoothness but is also costly and the use for the purpose had to be selective and based upon the nature of the alloy to be plated. For this reason preplating treatment was not only somewhat critical but it involved a large number of operations and was costly.

It is somewhat of a paradox that the first really successful method of plating aluminum involved anodic formations whereas all previous attempts sought to eliminate all traces of oxide.

In the Travers' Krome-Alume method, anodic oxidation after cleaning, is the primary step. Curiously enough the more perfect the anodic coat, the greater adhesion established. It follows, therefore, that maximum adhesion will be had with the purer forms of aluminum like 2S and 3S. Here the anodic coat is hard and resistant and it reaches a thickness not obtainable with the various aluminum alloys. However it does not neces-

sarily follow that satisfactory adhesion cannot be established on other than the purer forms of aluminum. All forms of aluminum may now be plated with a form of adhesion that is not in the least disturbed by sudden applications of heat sufficient for soldering, grinding and so forth.

The present commercial applications of the process are naturally limited to the defense industry and no aluminum is at the present time being plated for purely decorative purposes. Only what might be called functional plating is being practised. Aluminum is being plated with copper for soldering purposes, with brass for purposes of rubber adhesion, with cadmium for corrosion, with nickel and chromium for wear resistance.

When it was first proposed that aluminum be plated with copper or brass, many metallurgists were loathe to believe that the combination of these metals was practical from the standpoint of the results that might ordinarily be expected on the basis of the electro chemical theories. Aluminum and copper are far removed in the theories and prudential differences would ordinarily be high. This would be quite true if ordinary methods of plating were used but in the Krome-Alume process there remains between the copper and the aluminum bases metal the remnants of an anodic film and salt spray tests indicate that this new factor greatly interferes with what might ordinarily be a rule. Aluminum plated with .001 of copper has been able to withstand nearly 500 hours of salt spray testing before any form of serious corrosion set in.

At this point it will be interesting to trace the operations involved in the actual practice of the process. The cleaning of the aluminum does not have to be either severe or excessive. As a matter of fact only the mildest cleaners are advised inasmuch as no etching of the basis metal is needed for purposes of adhesion. An ordinary solution of sodium cyanide is quite sufficient for this purpose and cleaning can be accelerated to some extent by an application of direct current. The cleaning cycle is not much longer than that required for any other metal.

After the cleaning has been completed and rinsing has taken place, the aluminum to be plated is placed in an oxalic acid solution and anodizing proceeds for ten minutes by the use of alternating current. The alternating current source is variable in voltage between 5 and 50 in 5 volt steps. To prevent undue flow of current at the start of the anodic treatment, only 5 volts is applied. After a few seconds anodic formation

has proceeded to such a point and has imposed such resistance that a rapid increase to 50 volts is possible. This occurs during the first minute of treatment and after the voltage has reached 50 anodizing continues for 9 minutes more.

For some reason not thoroughly understood, anodizing by alternating current with oxalic acid seems to produce a form of anodic coating that is particularly adapted to plating. In operating the anodic bath, the current is allowed to flow between two work rods, each bearing the same number of aluminum articles to be plated. As each piece is the same size and shape, it follows that current density distribution will be eevn and uniform. This produces a uniform anodic coat on all articles treated.

Inasmuch as the oxalic acid anodizing solution should not operate over a temperature of 85° Fahr., some method of cooling must be installed where tanks are worked hard during the summer time. Cooling can often be achieved by merely installing a cooling cowl in the rinse tank. In larger installations where a great amount of work is to be done, a refrigerating process is indicated.

The crux of the Krome-Alume process lies in a modification of the anodic film before plating. Should a freshly anodized piece of aluminum be placed in any one of the nickel baths, very low cathode efficiency would result and a gritty deposit that could be easily removed with the fingers would result. Although the fact has not been definitely established, it would seem that this anodic surface is highly polarized by the occlusion of hydrogen or perhaps both hydrogen and oxygen inasmuch as the anodizing is done with alternating current. Subsequently this anodic surface must be plated in such a way as to eliminate the polarization. This is done by exposing the anodized metal to any one of a number of solutions that may be alkaline or acid. Best results are had by modifying this anodic film in a solution of hydrofluoric acid.

In the case of the purer forms of aluminum like 2S or 3S metals, there may be considerable latitude either plus or minus in the modification of the surface. The time will depend in any case entirely upon the strength of the hydrofluoric acid solution. 2S metals may be modified in anywhere from three minutes to fifteen minutes. On the other hand even very weak solutions of the hydrofluoric acid will modify the anodic coat on duralium surfaces very quickly. In some instances no more than thirty seconds are required to so alter the character of the coating that plating may be done.

It is quite natural that the temperature of the hydrofluoric acid would have some effect upon the speed of the modification. However this factor is so small that unless the hydrofluoric acid solution is at an excessive temperature practical operation does not call for strict control.

In the case of all the duralium alloys, modification is rather critical and it comes easily within commercial practice. If the metal is left in too long, the larger part of the anodic coat will be entirely removed and bad adhesion will result. If the exposure is not sufficiently long, poor adhesion will also result. It is to be pointed out that the anodic coat formation on the duralium alloys are not nearly as thick as they are on the purer forms of aluminum. Consequently modification proceeds at a more rapid rate.

After modification has been completed, the articles to be plated are rinsed and they may thereafter be plated in most of the commercial plating solutions now in use. The only exceptions to this rule are in connection with the high temperature, high ph alkaline solutions. If direct plating is attempted with such solutions modification of the anodic coat proceeds beyond a critical point before a deposit of metal can be achieved. Therefore when plating is attempted in these solutions it is usually necessary to plate a flash deposit on the metal before it is placed in the high alkaline bath. For instance before articles are placed in high temperature copper plating baths, it is necessary to expose the metal to ten minutes of plating in an acid copper bath.

In all other cases involving the majority of the plating solutions now in use, the aluminum articles may be placed directly in these baths immediately after modification and rinsing. Direct deposits of cadmium, silver and brass may be had in this way. Plating proceeds at the same rate of deposit as for the more common metals. Excellent nickel deposits may be had from any of the commercial nickel baths whether water hot or cold, white or gray. In the case of all deposited metals, the adhesion is either as good or in many instances better than that obtained over other metals. It has been found that with most aluminum alloys or the purer forms of aluminum, the adhesion obtainable is better than that had on zinc or its alloys when even the most approved form of technique is used. In the case of 2S and 3S metal adhesion reaches a point where it is practically impossible to remove the deposit except by rather violent chemical means. Such deposits may be heated in Bunson flames, bent, ground or flexed to the breaking point without risking the danger of

lifting the plating. In every instance heat increases the adhesion rather than decreases it. In one test aluminum sole plates for flat irons have been plated, heated to 700° and quenched in buckets of cold water without affecting the adhesion of the deposit. The alloy used was #195 of the Alcoa series. In this case as well as in all others heating increased the adhesion. The test was conducted with a deposit of .001 nickel and .0015 chromium. In the plating of 2S and 3S sheet material a form of adhesion is achieved that makes it possible to punch and form these metals after plating. Prior to the opening of hostilities, a number of manufacturers were punching and forming many articles from pre-plated sheet material. Embossing was also practiced with pre-plated sheets. Before the war this material was available in large sheets and also in strips.

The defense industry has discovered many functional applications of plated aluminum. The radio industry in particular has discovered a number of uses for plated aluminum and aluminum alloys. One of these has to do with greatly increasing the electrical conductance properties of aluminum through the application of silver. Where very high frequencies are employed conduction losses have been reduced as much as 18%. This is quite easy to understand when it is known that these ultra frequency currents exhibit what is known as a skin effect. They travel only on the surface of conductors. Prior to the introduction of the Krome-Alume process for this purpose, radio engineers were loathe to use uncoated aluminum in radio operators operating in the UHF range.

The radio industry has also long thought deposits on aluminum that would be sufficiently great so that soldering by ordinary means at ordinary speeds would become possible. However where silver is applied directly to aluminum soldering is not possible although the silver deposits will withstand an application of heat far in excess of that required for soldering. The reason is very simple to understand. Apparently the silver on the surface of the aluminum passes into solution with the tin in the solder; the silver is literally dissolved from the surface of the aluminum. When this happens the bare aluminum surface is left underneath and ordinary solder will not hold. Therefore when soldering is required on silver plated aluminum, a flash deposit of nickel is placed on the aluminum first. Then when the silver passes into combination with the tin, a nickel surface is left which takes the solder very nicely. Zinc directly on aluminum can be used if the proper precautions are

taken. The temperatures used must be comparatively low with a large volume of heat available. Otherwise the zinc deposit will be melted.

Any one of the aluminum alloys may be made quickly available for ordinary soldering technique with a flash deposit of copper. About 12 to 15 minutes in a copper bath is sufficient for this purpose.

Cadmium deposits made directly to aluminum are claimed by some authorities to be equally effective as anodic coatings. Such deposits are now being made commercially and apparently there is excellent promise for cadmium plated aluminum in the future.

Recent experiments have shown that comparatively small deposits of nickel and chromium placed on the top of aluminum pistons used both in gasoline and Diesel engines may very effectively reduce burning on this area. It is obvious that at these elevated temperatures the alloying action between the deposit of nickel and the bases metal must be rather advanced.

Brass deposits made directly to aluminum surfaces were held in suspect by many metallurgists for the same reason that copper deposits were held in suspect. Ordinarily one would think that because of the wide separation between brass and aluminum and copper and aluminum in the electro chemical theories quick trouble from corrosion would result. In the case of aluminum however there is an X factor in what remains of the anodic coat which takes its place between the bases metal and the deposited metal. The intervention of this coating has turned out to be a constructive factor inasmuch as many salt spray tests have confirmed the fact that corrosion does not proceed at a rate that might be expected. A deposit of copper of .001 in thickness has shown salt spray resistance up to 400 hours. While brass deposits do not run this high, they are sufficiently high to be much better than brass deposits on such metals as zinc.

Excellent oxidized decorative effects may be had on brass plated aluminum and brass plated aluminum has also been found to be very useful where it is required that rubber be adhered to aluminum surfaces. It has long been known that brass plated steel offers an excellent surface for rubber adhesion. Apparently there is some form of involved chemistry that takes place between rubber and brass when left in contact. Aluminum deposited with brass makes it possible to obtain a form of

rubber adhesion that is in many instances limited to the tensile strength of the rubber applied. To date a great deal of brass plated aluminum has been used by the rubber industry in connection with the production of certain aircraft parts.

Work done to date would indicate a great promise for small duralium machine parts covered with deposits of nickel and chromium or nickel alone. In one instance, it was found that the speed of a certain machine could be doubled by the use of certain aluminum components. The wear on the aluminum alloy surfaces was so excessive however that the metal could not be used in an unprotected form. In such instances aluminum covered with deposits of nickel and chromium offer excellent promise. Deposits of hard or soft nickel may also be used. The poor lubricating qualities of chromium have been largely overcome by porous deposits whereas nickel itself offers no lubricating problems. Work already done by some of the large automobile companies also indicate that there is great promise for aluminum pistons plated with nickel and chromium. These deposits do not have to be heavy to achieve the results required.

A careful analysis of the possibilities of plated aluminum cannot help but lead to recognition of the fact that plating will lead to many new applications that have been heretofore been denied this metal. Previous processes for plating the metal have been both expensive and uncertain except perhaps in the case of chromium direct which, from a metallurgical viewpoint, is not all that is to be expected. Heretofore nickel deposits have not been sufficient adherent to warrant extensive application and deposits from alkaline solutions have been difficult and uncertain.

Extensive use of the Krome-Alume process shows that the cost of plating aluminum is not much higher than that for plating other metals. If the copper cycle is included in zinc plating, the plating of aluminum is as cheap if not cheaper. The pre-plating process or treatment for aluminum averages about a quarter of a cent per square foot. The time required for the pre-plating treatment varies with the alloy to be plated. In the case of 2S and 3S metals about 15 minutes is required whereas the duralium series requires about 12 minutes. Standard tank equipment is used and all equipment is standard except the special transformer required for the anodizing. It is to be noted however that alternating current equipment for anodizing is much cheaper than direct current supply.

1943 AMERICAN ELECTROPLATERS' SOCIETY CONVENTION

The committees in charge of the National American Electroplaters' Society Convention, Buffalo, June 7-8-9, 1943, are busy rounding off the corners to produce a convention that will give an extremely effective boost in the War effort.

The committees meeting at least every two weeks are ironing out the many details, and developing new ideas. One of which is in the making is a "Bull Session", where all guns are parked outside the door, and where everyone can unload and absorb freely of the all important subject of Electro Plating.

The Convention Headquarters is the Statler Hotel, with ample facilities to handle the Convention, whether meetings, exhibits, banquet, or rooms for those attending. Every activity under one roof.

All talks are to be devoted entirely to the dissemination of knowledge to increase War Production.

We have steam up, boys, and are starting the machine for the best Convention for the "Advancement of the Science of Electro-plating" joining in the War Effort for an

Early Victory.

Sincerely, the Committees.

BRISTOL PUBLISHES BINDER OF BULLETINS ON AUTOMATIC CONTROL INSTRUMENTS FOR INDUSTRIAL FURNACES, KILNS, AND OVENS

The Bristol Company, Waterbury, Connecticut, has just published a series of bulletins covering automatic control and recording instruments for industrial furnaces, dryers, kilns, and ovens. These have been bound together in loose leaf form in order that additions and revisions may be easily inserted.

The binder set covers pyrometer recorders and controllers, thermometer recorders and controllers, humidity recorders and controllers, draft controllers, control valves and accessories.

The bulletins included are well illustrated with photographs, application drawings, and wiring diagrams, and the material included gives a wide selection of types and combinations to meet the needs of manufacturer or user.

HARD CHROME AND THE PERISHABLE TOOL SHORTAGE

Right at this moment we are faced with a shortage of perishable tools. Drills, reamers, taps, gauges and similar items are probably the most involved. Manufacturing facility for small tools is being taxed to the limit. Still the shortage grows. Obviously something will have to be done about it.

Fortunately there IS something that can be done about it. It is possible to extend the life of cutting tools tremendously by a method employing hard-chrome plating. The procedure is at least ten years old, and has been improved considerably in the last few years.

Naturally the question arises, "Why has not such a valuable procedure become universal during the decade just past?" It is the purpose of this article to explain why.

In order to make use of hard chrome in prolonging tool life, it is necessary to adjust our whole method of using tools. Instead of using a reamer or a drill until it is hopelessly worn, it is expected that the tools will be first given a light application of hard-chrome plate before putting into service, and then subsequently removed from service for retreatment before the chrome coating is worn through to the steel.

After removal from service, the tool is stripped of the remaining chrome, replated to the exact original size and put back into service. Except in unusual cases, it is not necessary to finish-grind after replating.

It can plainly be seen that the installation of such a scheme, involving the rotation of tools in and out of service, would be quite an undertaking, not because the method is at all arduous, but because it involves development of an entirely new routine of tool use.

It must be remembered, also, that the hard-chrome tool-saving method was advanced in the year of 1932, at the depth of the Depression. Manufacturing organizations at that time were more concerned with getting something to machine rather than with the question of how to machine it.

Instead of today's tool shortage, there was, in those days, a glut of manufactured articles, and the shelves of stock rooms and dealers' stores were loaded with merchandise that showed a perverse tendency to remain there.

In 1932, shop executives were covering their own jobs and the jobs of other previously employed executives, as well. With little output, men were spreading their activities almost to the tearing point. Is it remarkable that a new method, involving changes in the tool-using

habits of a lifetime, did not readily become popular?

Then too, you will understand that in most systems of cost accounting, small tools are written off completely just so soon as they emerge from inventoried stores. Assuredly a saving made possible in the life of small tools would not impress the major executive except without a detailed study which he was too preoccupied to make.

So the tool-saving program never got fairly under way. Various reasons were then offered by tool users as to why a method so readily susceptible of proof as an economy measure, was not generally accepted. It was variously construed as "too complicated" or perhaps "too messy" or "too much trouble."

Maybe the best way to explain why the process was not extensively used, is to remark, simply, that it was ahead of its time. As was said at the time Billy Mitchel was vainly tearing out his heart in the interests of military aviation, "The only thing worse than being completely wrong is to be right too soon."

But now the time has arrived when hard-chrome plating, as a means of breaking the tool bottleneck, begins to justify all the hopes and aspirations of its discoverers ten years ago and those who in later years have been instrumental in improving the process. There no longer lies any choice in the matter. We shall have to plate our small cutting tools with hard-chrome. Apparently we have no other alternative.

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Thundering overhead through the skyways of the world go the Pan American Airways Clippers in war as well as peace—bucking extremes in temperature and weather, often in quick succession—gruelling conditions that require the best in metal plating to protect vital parts. H-VW-M are proud that their electroplating and metal finishing equipment and supplies play a role in the maintenance of Pan American air monsters.

Leading manufacturers of planes and war machines are relying on the dependability of H-VW-M electroplating and polishing equipment and supplies—as well as the experience and technical advice of H-VW-M field engineers. An H-VW-M engineer, on request, will be glad to call and help solve your metal finishing problems.

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Concentrated PROTECTO Lead solutions have been used for years in preparing lead plating baths. Simply a dilution of the concentrate according to directions is all that is necessary. The resulting plating solution produces smooth, dense, adherent deposits on most metal surfaces. A copper flash is only required for a few special applications.

PROTECTO LEAD SOLUTION is used in preparing lead baths which are to be operated at moderate current densities. A working solution is made by diluting approximately one part of the concentrate with three parts of water.

SUPER-PROTECTO LEAD SOLUTION is a concentrate with a higher gravity. It can be diluted with water to produce a solution identical with the PROTECTO solution or with less dilution to prepare a solution that is capable of being operated at current densities of up to 30 or more amperes per square foot. Use of this Super-Concentrate saves handling and higher freight charges.

Both solutions are essentially lead fluoborate stabilized with an excess of fluoboric and boric acids. This balance serves to prevent treeing and to promote smooth deposits.

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Masters' Electro-plating Association

January, 1943

RATE OF OPERATIONS

•

THE rate of operations among the members of the Association for the week ending Jan. 16 was 68% compared with 65½% in December and 76% in January, 1942.

The rate of operations continues to increase at a slow but steady rate.

OIL SHORTAGE

A number of Members have been notified by the Petroleum Administration and the WPB to convert their oil burning boilers to coal in order to conserve oil in our present shortage. It is important that members act immediately on these notices to comply with them if possible, or to obtain permission to continue with oil and to get the necessary fuel if it is not possible for them to convert. Members desiring further information on this subject should call the Association headquarters.

LEAD PLATING COMING IN

At the January meeting of the Association, a communication was read from Mr. George B. Hogaboom of the WPB recommending close attention to lead plating in the future, because of more severe restrictions on zinc and other metals. The letter recommended investigation of the lead plating solutions developed by the Dupont Co., Wilmington, Delaware (the sulfamate solution), and by the Harshaw Chemical Co., Cleveland, Ohio (the fluoborate solution).

Full details of these solutions can be obtained directly from the above companies.

NICKEL ANODES REQUISITIONED BY WPB

The Association recently sent a representative to Washington to discuss with the Nickel Branch, the problems of several Members who had been asked to turn over their nickel anodes to the Government. The Association obtained permission for these Members to retain their anodes until they could submit the type of information required by the Nickel Branch. One of the platers involved, reported that he had received permission to retain his anodes permanently.

WAGE RATES

A communication has been received from the U. S. Dept. of Labor, Wage and Hour Division, asking if the plating industry would be affected by an increase in the legal minimum rate of pay from 30c per hour to 40c. The Association has replied stating that the industry would not be affected by such a change.

PLATING WITH CADMIUM, LEAD AND OTHER HARMFUL METALS

An investigation of recent food poisoning outbreaks by the New York City Dept. of Health disclosed the fact that the food consumed had been contaminated with cadmium from the plating of evaporators of mechanical refrigerators, where the food was not in direct contact with the cadmium plated fixture, but where the cadmium nevertheless did gain entrance into the food.

Investigation further disclosed that despite previous warnings, cadmium had been used in replating refrigerator evaporators, shelves, broiler grids and other food utensils and equipment.

All persons engaged in plating are again warned by the New York City Department of Health, that the use of cadmium, lead or other deleterious metals in plating utensils, equipment and apparatus that may come in direct or indirect contact with food is prohibited by Sec. 145 of the Sanitary Code of New York.

Before replating any such equipment already coated with cadmium it is essential that the cadmium coating thereon be entirely removed.

A field test for the rapid detection of cadmium, which is easily performed, is available upon request at the Office of the Bureau of Food and Drugs, Dept. of Health, 125 Worth St., New York.

The Department also emphasizes that solder used in soldering food utensils and equipment where the solder may come in contact with food, may not contain more than 5% lead.

EXECUTIVE COMITTEE OF THE ASSOCIATION FOR 1943

At the January meeting of the Association the following Members were elected to the Executive Commitee for 1943.

Berkman Bros.	Muller Art Plating Works
Brust Bros.	National Chromium Corp.
Chas. Dietrich & Son	R. Plumacher & Son

Philip Sievering, Inc.

TRADE NOTES

Electroplaters have been asked to report to the Association if they are approached by a Michael Forte, formerly of Long Island City, who left a Buffalo concern, taking with him a number of expensive micrometers, aguges and other precision instruments.

SEND IN YOUR SCRAP

Tanks, planes, aircraft carriers—practically everything we need to win this war is made one-half from scrap metal. And America's steel mills must have six million more tons of scrap metal to keep up and even increase their present production rate. It's up to us to go through our shops, houses, and garages, and clean out all our old junk. Everything made of metal or rubber is desperately needed now. So are rags, manila rope and burlap bags. Give your junk to charity . . . sell it to a junk dealer . . . or take it to any place where you see the red, white and blue Official Salvage Depot sign. Throw *your* scrap into the fight!

CHANGE IN NAME AND INCREASE IN SCOPE OF A.E.S.

It is our feeling that the questions so far proposed are of too general a nature and it is our sincere wish and objective that the entire subject be clarified explicitly in all its details and ramifications. With this purpose in mind, we respectfully request that the sponsor or sponsors of these proposed changes delineate clearly exactly what the specific changes would be and how the Society will benefit by such changes. Until such detailed explanations are forthcoming we do not believe the Newark Branch, or any other Branch, can intelligently discuss the proposed changes. In order to facilitate such discussion we request answers to the following questions:

1. What is the object of the proposed change?
2. What changes do you propose to make in the Constitution to conform with this proposal?
3. What Allied Industries do you wish to include in the A.E.S.?
4. Is it intended to change Part II, Article II of the Constitution?

PART II, ARTICLE II

Article II Membership.

Sect. 1. Classes: The membership shall consist of two (2) classes, called respectively, Active and Associate.

Sect. 2. Active Members: These shall consist of foreman electroplaters, elected by a majority vote. Each applicant shall be required to furnish proof that he has been actively engaged in electroplating for at least five (5) years; one (1) year of which he must have acted in the capacity of a foreman plater or supervisor. He may also be required to pass such examination in the deposition of metals as may be deemed advisable by the Branch. A foreman plater or supervisor is hereby defined as an executive engaged in supervising and directing the personnel and production of a plating plant or department.

Sect. 3. Associate Members: These shall consist of any persons not qualified for active membership who are engaged in any phase of the electroplating industry and interested in the aims and welfare of this Society. Associate members shall be elected by a majority vote, and shall have all the privileges of an active member except being eligible to election to the Supreme Society.

Sect. 4. Change in Classification: Any member who has become qualified for a different membership under the above classification will be automatically deprived of all rights and privileges under the old classification and entiled to all rights and privileges under the new classification, when changed from one classification to the other.
Sect. 5. Applications: Applications for membership shall be made to the Secretary of the Branch Society with which the applicant desires to be affiliated, on an authorized form. This form is to be filled out and endorsed by three (3) members in good standing in that Branch.
Sect. 6. Familiarity with Constitution: Each applicant for membership shall receive a copy of the Constitution and By-Laws, which he shall be expected to read attentively, and he will not be allowed to plead ignorance for any violation.

5. Is it the intention of the sponsors to admit to membership anyone connected with or engaged in metal finishing, regardless of status, and if so, in what capacity, Active or Associate?
6. How will the Research Associates be regrouped to satisfy allied industries?
7. Is it intended to retain the Associate membership clause for Salesmen and Engineers?
8. Since the Preamble of the Constitution states it shall be the object of the Society to improve and disseminate "the art and science of Electro deposition and all its allied arts," why is it necessary to increase its scope?
9. What is meant by other Metal Finishing Divisions as discussed at the time of the original proposal? (Grand Rapids Convention.)
10. Is it not a fact that our Constitution, Article II, Section 3, states that anyone interested in the aims and welfare of the Society is now eligible for membership?
11. Is this a desirable time to attempt a rapid increase in the membership of the A.E.S. when the personnel presently employed in the Metal Finishing Industries and its allied arts are of an extremely transient nature?

For your consideration, we call to your attention the fact that the Newark Branch has always admitted to associate membership any qualified personnel of allied industries without changing the name of this Society. Such action is covered by Part II, Article II, Section 3 of our Constitution.

In view of the widespread effect of any such proposed changes, we are

taking the liberty of sending a copy of this letter to the Secretary of each Branch of the A.E.S. It is our sincere hope that our action will precipitate a clearer and fuller discussion of the problem now confronting the Society.

Since we have already taken this action we respectfully instruct that you publish this letter in the February issue of *The Review*.

WILLIAM F. BRUHNS,
President, Newark Branch

SWENEHART APPOINTED

Leland Lyon, president of Atlas Powder Company, announced yesterday that the executive committee has created a new department in the company to be known as the advertising and public relations department. John Swenehart, heretofore manager of the advertising department, has been appointed director of the new department. F. J. Horty has been appointed director of industrial relations and service.

ALLISON ADVANCED

On the twenty-third anniversary of the founding of Detroit Rex Products Company, the annual meetings of the stockholders and board of directors were held. At the latter meeting, Ellsworth W. Allison was elected Assistant Secretary of the Company.

Mr. Allison received his primary schooling through Junior College in Bay City, Michigan. He attended the University of Michigan and was secretary of the 1935 Law Class, the year of his graduation. He holds degrees of AB and JD from the Literary and Law Schools respectively.

Previous to joining Detroit Rex Products Company, Mr. Allison was associated for six years with the law firm of Lucking, Van Auken and Sprague in Detroit. He is president of the University of Michigan Club of Detroit, and is a member of the Detroit Boat Club.

YOUR HELP IS NEEDED

Files at National Headquarters are missing the following back numbers. Members who have no further use for these missing copies are urged to send them in to complete our permanent file.

1915	1916	1917	1918
February	January April	March	March
April	February June	April	October
June	March		December

1919	1920	1921	1922
September	May	January	October
November		March	November
		September	December

1923	1924	1925	1926
January	May	June	February
February	August	September	March
	September		

	1928	1929	
	July	January	
	August	February	
	November	March	
	December	May	

1931	1932	1933	1934
August	January	January June	March
September	August	February August	May
October	September	March	June
	November	May	
	December		

1935	1936	1937	1938
August	February May	January	April
September	March June	November	
October	April	December	

1939	1940	1941	1942
October	January	January	January
December	May	February	February
		March	

THE ABSTRACT SECTION

GEORGE WAGNER

Chairman Program and Educational Committee

The Structure of Brush-Plated Silver. By H. LANCE CROSBY and L. I. GILBERTSON. *Trans. Electrochem. Soc.* **82** (Preprint 21) (1942). Photomicrographs indicate that silver plated by means of a brush plating outfit has a lamellar, or "banded," microcrystalline structure, which is the probable explanation for the low porosity of such deposits as compared to silver plated on hot-rolled steel from a conventional bath without the use of a silver "strike." If a strike is used, the bath-plated silver has as low porosity as the brush plate; it is suggested that in bath plating the porosity is due to "an amorphous or disorganized layer of silver on the steel surface," which "does not form when a strike is used." A photomicrograph of bath-deposited silver shows two large crystals growing toward each other, and apparently developing a channel or crevice between them. The use of the strike improved the adherence of both brush-plated and bath-plated silver.

The Adherence of Thick Silver Plate on Steel. II. By H. LANCE CROSBY and L. I. GILBERTSON. *Trans. Electrochem. Soc.* **82** (Preprint 20) (1942). It has been found that excellent adherence of silver plate on steel is obtained if (1) the cathode is connected to the current source before immersion in the "strike" bath; (2) the current density is high enough to cause vigorous gassing in the strike; and (3) the cathode is completely covered in the strike, without appreciable "treeing." These results were confirmed, and it was found that the roughness of the steel surface had no effect on the adhesion, so that mechanical "keying" or interlocking of the silver and the steel is not important. Photomicrographs show, when the strike was not used, a zone of unstable, disorganized silver crystals next to the steel, accounting for the poor adhesion and rapid corrosion rate. When the strike was employed, silver crystals appeared to originate at the corners of the ferrite grains or between adjoining ferrite crystals, and then bridged over the ferrite grains. The silver plate then contained twinned crystals, where as the deposits on unstruck steel were of broken crystals. The grains of the steel appear not to be continued in the silver deposit.

The Corrosion Resistance Afforded by Bright Dipped Cadmium Coatings. By GUSTAF SODERBURG. *Trans. Electrochem. Soc.* **82** (Preprint 14) (1942). The chromic acid bright dip for cadmium removes 0.00009″ or less of the plate, and passivates the surface. Outdoor exposure tests in a highly corrosive industrial atmosphere indicated that the corrosion resistance of cadmium plate 0.0001″ thick was not decreased by the bright dip, and a slight improvement was noted on plates 0.0003″ thick. It is suggested that the passivation produced compensates for the slight loss of metal in the bright dip.

Cathode Films in Tungstate-Containing Nickel Baths. By M. L. NIELSEN and M. L. HOLT. *Trans. Electrochem. Soc.* **82** (Preprint 11) (1942). A copper cathode was electrolyzed for 10 sec. at 93 amp./sq. ft. with only the lower half submerged in a tungstate solution, and then washed in a heavy stream of water. No tungsten deposited on the copper. The cathode was then plated for 10 sec. at 46 amp./sq. ft. in a Watts nickel bath. Nickel was deposited on the upper half only.

It is believed that a film formed on the lower half of the cathode in the tungstate solution which prevented nickel plating. There was often a blue layer of reduced tungstate on the cathode after electrolysis. The film could be removed by a dip in an alkaline solution, or hydrogen peroxide before nickel plating, but not by a dip in acid. The tungstate solution had to be distinctly acid (pH less than 5.5) and sufficiently strong (tungsten concentration more than 3 g./l) to form the film; moreover, the use of current was required. The effect of adding tungstate to a nickel bath was studied with a rotating cathode; nickel-tungsten alloys were obtained, which deposited at lower efficiencies and with less metallic appearance when the speed of rotation was increased from 450 to 7,200 RPM. The addition of tungstates to the Watts nickel bath lowered the "precipitation point" of basic material from a pH of 6.2 to 5.4. Tungsten-Zinc alloys were deposited at lowered efficiencies from an acid zinc bath containing tungstates, but there was no effect on an acid copper bath. The action of the film in preventing or permitting the deposition of tungsten is discussed.

Diffusion Theory of the Codeposition of Gold and Copper. By MALCOLM DOLE. *Trans. Electrochem. Soc.* **82** (Preprint 15) (1942). Data on the plating of gold-copper alloys are discussed to elucidate the factors governing alloy plating. As the current density is increased, the percentage of gold in the deposits drops to a certain point, and then remains constant as the current density is raised further, indicating a maximum rate at which gold can be deposited; a maximum is found likewise for copper. Current in excess of these maxima is used in evolving hydrogen gas. It is commonly observed that increasing current density in alkaline baths does not increase the rate of deposition because the current efficiency falls off.

To explain the existence of these maxima, it is pointed out that metal is supplied to the cathode only by diffusion and convection in the bath, since the complex metal ions migrate away from the cathode, not towards it, by electrical attraction, while the concentrations of the free metal ions are negligible. Calculations show that the maximum rate of deposition of gold and corresponding gold plating current are controlled by the rate of diffusion of the complex gold cyanide ion to the cathode, since "(1) increase of current density beyond a certain value fails to increase further the gold plating current; (2) increase of ('free') cyanide ion concentration has no influence on the gold plating current; (3) increase of temperature increases the gold plating current to the extent predicted by the diffusion theory . . .; (4) dilution of plating solution . . . to twice its volume halves the (gold) plating current." The diffusion theory alone does not explain the observed copper plating currents because: "(1) addition of excess ('free') cyanide ion decreases markedly the copper plating current; (2) increase of temperature increases the copper plating current more than is predicted on the basis of the diffusion theory; (3) the copper-to-gold plating current ratio is much smaller than predicted on the basis of the diffusion theory." It is suggested that the rate of deposition of copper and the corresponding plating current is controlled by the slow dissociation of the cyanide copper complex, a concept which has been used to explain the dissolution of copper electrodes in alternating current electrolysis of cyanide solutions, and which agrees with the present data. Equations for calculating the diffusion currents are given.

Electrodeposition of Iron-Tungsten Alloys from an Acid Plating Bath. By M. L. HOLT and RODNEY E. BLACK. *Trans. Electrochem. Soc.* **82** (Preprint 27) (1942). When sodium tungstate is added to a ferrous sulfate iron-plating bath, the cathode efficiency drops rapidly to about 25%, and the tungsten content of the plate rises slowly to about 35%. The efficiency drops when the temperature rises above 50° C., and rises as the current density is increased up to 200 amp./sq. ft. The efficiency was somewhat better when the pH was 2.5 than 1.7. The deposits varied in appearance, but were best at high bath temperatures; they often included oxides. They were not very resistant to corrosion by HCl, but were improved by reduction in hydrogen at 975° C. When methane was present during the reduction, the deposits

became dark and quite resistant to corrosion, even by aqua regia. Rotating the cathode decreased the current efficiency and increased the tungsten in the deposits. In both iron and iron-tungsten baths, the cathod potential fell off sharply at current densities below 1.4 amp./sq. ft., and no metal was deposited, but hydrogen was evolved. Explanations for these observations are given in terms of a semi-permeable cathode film, and reduction of tungstate by atomic hydrogen and "unstable, active" iron, both deposited at the cathode.

Control of Ammonia in the Electrodeposition of Brass. By J. H. MONAWECK. *Trans. Electrochem. Soc.* **82** (Preprint 28) (1942). The common analytical method for determining ammonia in brass plating baths gives very high results, due to generation of ammonia from the cyanide during distillation. If HCl is first added and the cyanide is distilled off before the ammonia distillation, the results for ammonia are still high and for cyanide are low, due to generation of ammonia from cyanide in the precipitate remaining from the acid addition. The following method gives good results: To a 10 cc. sample of the plating solution, add 25 cc. water and 25 cc. 1-4 H_2SO_4. Filter off precipitate and wash with 50 cc. water. Evaporate filtrate until white fumes appear. Cool, and dilute to 250 cc.; add a few drops of phenolphthalein and then solid $Ca(OH)_2$ until the slurry turns pink. Distill for ½ hour in kjeldahl apparatus, collecting the NH_3 distillate in standard acid. Titrate the excess acid. A small amount of ammonia is formed in preparing the brass bath, and more is generated during plating; at 83° F., a final concentration of 0.21 g./1. was reached. The effect of ammonia on the composition of the brass plate was studied. A brass solution analyzing Cu 15.04, Zn 7.93, NaCN + $Na_2Zn(CN)_4$ 31.35, free CN 7.6, NH_3 0.127 g./1.; pH 10.7, at 83° F. gave a plate with 79.9% Cu, and the copper decreased about 2.7% for each additional 0.1 g./1. of NH_3. Raising the bath temperature by 1° F. increased the copper in the plate by about 0.5%.

Cyanide Zinc Plating Baths. By R. O. HULL and C. J. WERNLUND. *Trans. Electrochemical Society* **80** (Preprint 36) (1941). Zinc is the preëminent low-cost metal coating for protecting iron and steel against rust. Cyanide zinc baths offer the advantages of high throwing power and the capacity for bright deposits; disadvantages are slower speed of deposition than acid zinc baths, higher solution and maintenance cost, and inability to plate malleable and cast irons. The *"straight" cyanide* bath offers the highest efficiency, but the deposits do not have an attractive appearance. The *zinc-mercury* bath produces uniformly white deposits and has good covering power. *Bright zinc* baths demand careful control and high purity. Discussing the constitution of zinc baths, the authors suggest that zinc is present largely as sodium zincate, Na_2ZnO_2, and only in small amounts as sodium zinc cyanide, $Na_2Zn(CN)_4$. Without cyanide, sodium zincate solutions deposit metal at high efficiency at low current density, but the plate is spongy and poor. On the other hand, without sodium hydroxide, cyanide zinc deposits are white but the current efficiency is very low. The functions of the cyanide are (1) to combine with zinc compounds to form soluble complexes; (2) to assist in obtaining a good deposit; (3) in excess, it lowers the cathode efficiency. The effect of the sodium hydroxide is (1) to provide a high current efficiency; (2) to afford good conductivity; (3) to assist in anode corrosion. The pH should be between 12.2 and 12.7. Although the chemistry of the bath is not clear, very satisfactory control is had by regulating (1) the sodium hydroxide content, and (2) the ratio M of total cyanide to zinc metal. The following baths are recommended:

Three requisites for bright plating are given: (1) elimination of small traces of

	STRAIGHT CYANIDE		ZINC-MERCURY		BRIGHT ZINC	
	Customary	High-speed	Still Tank	Barrel	Still Tank	Barrel
Zinc cyanide, $Zn(CN)_2$	8 oz./gal.	12 oz./gal.	5 oz./gal.	8 oz./gal.	8 -11 oz./gal.	8 -11 oz./gal.
Sodium cyanide, NaCN	7 "	5 "	3 "	4 "	2.5-8.5 "	4.5-10 "
Sodium hydroxide, NaOH	7 "	12 "	4 "	6 "	10 -15 "	10 -13 "
M, Total cyanide / Zinc	2.0-2.5	2.2-2.6	—	—	2.0-3.0	2.5-3.2
Temperature	104-122° F.	104-158° F.	86-104° F.		82-100° F.	
Cathode efficiency	90-95%	85-95%	90%		75- 95%	
Current density	9.3-19 amp. per sq. ft.	55-110 amp. per sq. ft.	up to 40 amp. per sq. ft.		10-50 amp./sq. ft.	
Anodes	Zn 99.75% +	Zn 99.8% +	98.25% Zn + 0.5-1% mercury		99.8% + Zn; some baths use additions of Al, Hg. Ca, or Mg.	
Addition agent	—	—	Use .03 oz./gal. mercury salt in bath.		Various addition agents used in baths; sodium sulfide or zinc dust for purification.	

metallic impurities (by adding 0.33 oz./gal. sodium sulfide, bisulfite, or thiosulfate, which precipitates lead; or by adding 0.33 oz./gal. zinc dust, stirring, and filtering); (2) rigorous control of solution composition, especially the ratio M; and (3) use of a bright dip of 0.25-0.5% nitric acid or 4% hydrogen peroxide with 0.25% sulfuric acid after plating (not required with certain brighteners, as molybdenum). Ammonium thiocyanate-formaldehyde resin, phenol thiocyanate, thiourea-formaldehyde resin, methyl ethyl ketone, molybdic oxide, piperonal, gelatin with certain oxyheterocylic compounds, and thiourea with certain metal brighteners, are employed as addition agents to improve luster, extend the bright current density range, and improve covering power. For each pound of zinc deposited, approximately 1/3 pound of sodium cyanide and 1/9 pound of caustic soda are consumed. Complete instructions for analysis of the baths are given. The use of various types of anodes, including inert steel anodes, is expounded; with pure anodes, the metal content rises due to chemical attack, and it is necessary to reduce it by using a few insoluble anodes or alloying additions to zinc anodes. For testing the thickness of coating and expected corrosion resistance, the Preece test and salt spray, though widely used, are of little value; magnetic tests or dropping tests are preferred. Cyanide zinc deposits, though somewhat less ductile than those from the acid zinc bath, are dense, relatively free from pores, and fine-grained. Zinc electroplated from either acid or cyanide baths is of excellent quality and is less brittle than hot-dipped zinc coatings. The paper is an excellent exposition of the complexities of cyanide zinc baths and practical methods of obtaining simple, satisfactory operation; it merits the close study of all persons interested in this type of plating.

Studies on Overvoltage. XIII and XIV. By A. L. FERGUSON and MYRON B. TOWNS. *Trans. Electrochem. Soc.* **82** (Preprints 25 and 26) (1942). Overvoltages are doubtless of great significance in electroplating, although our present understanding does not give a very clear picture of the mechanism of either plating or overvoltage. These papers are of interest to platers as the most recent work on overvoltage, and appear to achieve an acceptable explanation of hydrogen overvoltage at a platinized platinum cathode, and to challenge previous theories on overvoltge. It is found that the potential is influenced by conditions on the *solution* side of the double layer at the cathode. The diffusion of hydrogen away from the cathode appears to be of primary importance, apparently by affecting the activity of the hydrogen atoms and hydrogen ions at the interface. Similar processes doubtless apply to many plating problems, and we may hope that further progress in such studies may eventually yield results of value to the plater.

THE QUESTION BOX

There is considerable interest among the readers in The Question Box. However, the feature has been difficult to handle because some months almost no material is received and at other times several pages are sent in. It is suggested the secretaries stimulate added interest so sufficient material may be received each month to make the Question Box a lusty department.

DETROIT BRANCH

What effect has the sulphate content of an anodizing bath upon the film? Also, what is the effect of chlorides?

Ans. Sulphate in excess of .6 g./liter tends to make the film transparent. In addition to this, sulphate might be absorbed in the film. Chlorides would tend to be driven off by electrolysis.

Are dyed anodic coatings intended to replace painting?

Ans. They are not intended to replace painting but merely to supplement it.

How is a porous chrome deposit produced?

Ans. One method of producing a porous deposit is to reverse the current for a short period at the end of the deposition period. Vendors of chrome plating processes should be consulted and they can undoubtedly suggest many other methods.

What is a good lining for use with sulphuric acid solution for anodizing?

Ans. The tanks could be lined with lead, acid proof brick, plastics, rubber or a combination of these. This should offer no particular difficulties.

Can tanks used in anodizing be made wider to avoid using glass lining for insulation?

Ans. In as much as the glass lining is merely used for insulation for the prevention of shorts, widening, the tank would probably help. However, using more care in racking would accomplish the same purpose.

In chromic acid anodizing is there an optimum ratio of anode to cathode surface?

Ans. Since the load is usually a very small area compared with the anode it appears unlikely that such is the case. No one has ever reported difficulty because of this.

What is a measure of the quality of an anodic film on aluminum?

Ans. Government specifications usually insist on a 250 hour salt spray.

Can chromic acid used in anodizing be recovered when the bath is spent?

Ans. No method for doing this in the plant is known. However, if one feels economically justified, it can be returned to the manufacturers of chromic acid who may recover it.

How is pH controlled in chromic acid anodizing?

Ans. By discarding some of the bath and adding sufficient fresh chromic acid to bring pH down to desired value.

What is the relative porosity of chromic acid film compared to sulphuric acid film on aluminum?

Ans. So far as known there is no difference in porosity.

What causes a powdered finish on 24 ST aluminum rivets?

Ans. This phenomena is probably caused by too high temperature of bath or too high a pH.

Can Hydrogen embrittlement be removed by the use of infra-red radiant energy?

Ans. This can and is being done commercially. A temperature of 400°F. can be reached in 2 minutes using infra-red lamps. This will successfully remove hydrogen in a few minutes.

Can radiant heat be used for baking clear coatings over a highly reflecting surface?

Ans. This can be done but not very efficiently because a large amount of energy would be lost by reflection.

Is it possible to sputter gold on pyrex glass for a radiant energy reflector?

Ans. In order to prevent the diffusion of gold into metallic reflectors this has been resorted to, but better practice is to use aluminum with a treated surface. This maintains its efficiency over a long period of time and is not as fragile as glass.

Has anyone ever tried plating nickel under gold to prevent the diffusion of gold into base metal?

Ans. This has been tried but does not prevent diffusion. The only metal tried which prevents diffusion is iridium.

Is it possible to use radiant heat for drying parts after zinc plating without causing stains and spots?

Ans. Radiant energy is very effective in this application. The water evaporates from the work at a comparatively low temperature and leaves the parts stain free.

What are the possibilities of using induction heating for baking paint?

Ans. It can be used on heavy gauge material but is altogether too fast for the lighter gauges, due to the rapidity of heating.

EDGAR A. HAHN, *Librarian*

PHILADELPHIA BRANCH

Is it possible to deposit cadmium by immersion on steel?

Ans. There are several patented baths on the market (alkaline baths) that are available. Oliver P. Watts in his book, "Laboratory Course in Electrochemistry," describes such formulae.

What is the maximum amount of copper allowable in a chromeplating bath as an impurity and what means can be taken to remove this impurity?

Ans. When the copper attains a concentration of 4 to 5 oz. per gallon, the efficiency of the bath decreases markedly. There is no known method by which it can be removed. In trying to remove the copper by electrolysis copper oxide is formed by the strongly oxidizing effect of the chromic acid. This drops from the cathodes and is redissolved in the bath.

Why does a nickel plating bath of a low pH (1.9) plate on a previous nickel plate, while the plate of a higher pH bath does not always adhere?

Ans. Possibly the lower pH or higher acid concentration has an activating effect on the previous plate.

What is the cause of a cadmium plating bath turning a deep coffee color?

Ans. It may be due to organic impurities, formation of ferro-cyanides, or possibly, of excess carbonate in the bath.

Has anyone used Albachrome as an addition agent in chrome plating what are its results?

Ans. One member stated that through its use the cathode efficiency is increased over that of the ordinary sulphate bath. Such an agent is also described in January, 1943, issue of Metal Finishing.

How can scale be removed from Mumetal? (Composition of Mumetal is 75% Ni, 5% Cu, 2% Cr and 18% Fe.)

Ans. Try Bullard Dunn process or molten caustic soda.

How can copper be plated on plaster of paris with a bright finish?

Ans. Impregnate plaster of paris thoroughly with wax for about twelve hours. Then bake in an oven to remove excess surface wax. Leave on enough

for subsequent dusting on of bronzing powder or graphite. Wire up so that proper conductance of current is obtained. Then silver flash and copper plate. The smoothness of the undersurface and the fineness of the bronzing powder, also the use of one of the "bright copper" baths are prime factors in brightness of the final finish, less polishing being required.

HENRY G. ORLIK, *Librarian*

CHICAGO BRANCH

What is the best method of construction and what materials to use for a plating room floor and etching set up?

Ans. One chemical engineer stated that a high melting point pitch such as #2 Korite made by the Standard Oil Co. put over wood or concrete ¼ to ½ in. thick would outlast concrete 4 to 1. Another member stated that he had installed a plating room floor as follows, first lay out the drains, then lay the concrete, then a covering of high melting point pitch, then tar paper, light coat of pitch, then set acid proof brick in cement, around the dipping tanks the bricks were also covered with pitch, this floor was on the sixth floor of the building and has no leaks after a large number of years.

Will a piece be more uniformly plated if held at 3 points than if held only at one point if the contact area is the same in both cases?

Ans. One point of contact is satisfactory, when 3 points are used it is only to hold the parts firm and in place.

Is it difficult to plate silver on steel without an undercoat and what is the procedure?

Ans. Clean the steel, dip in muriatic acid dip, and run through two silver strike solutions, then transfer to the regular silver plating solution.

What causes a new mechanical nickel solution to plate brownish color. 6 oz. metal, 4 oz. boric acid, 4 oz. nickel chloride. pH 6, Temp. 90°?

Ans. After some discussion it was thought that the electrical contacts were at fault.

How can silver plating be done on plastics?

Ans. Metallize, or try the Vacuum plating process.

J. W. HANLON, *Secretary*

LOS ANGELES BRANCH

Can we still silver plate without priority? I want to plate some knives and forks.

Ans. Can still use for repair work as long as you use foreign silver and do not use over 5 oz. per piece.

What to do? Threaded brass pipe fittings are cadmium plated, given a nitric bright dip and hot water rinse, then air dried, after short time the plate turns dark. Why?

Ans. Try using a neutralizing dip, such as mild cleaning solution or sawdust.

What can I use to take the place of gas so that I don't miss these interesting meetings?

Ans. Ride the car that uses electricity. It stops right in front of Hotel.

What causes cloudy effect on cad plated steel parts after chrome acid dip?

Ans. Contaminated chromic acid dips, carrying a little cyanide in the dip would cause this.

Can magnesium be anodized same as aluminum? Pt. 13?

Ans. It can be. (No explanation, however.)

What is the latest dope of the authorized W.P.B. on zinc plating instead of cadmium plating?

Ans. Order E.11 b provided you have worked for Army, Navy or Wright Field. Cadmium is available. Spec. A.N.T. 32 will be used for Zinc and cadmium on ferreous metals.

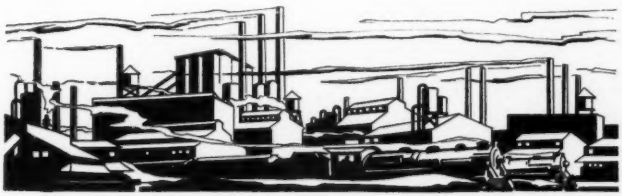
What causes an appearance of mildew on cadmium plated brass parts after they have been in stock for a while?

Ans. The old spotting out. After plating rinse in cold and hot water several times, or soak a while in lacquer thinner.

What causes stainless steel to rust?

Ans. The use of steel wool or steel wire brush or anything like iron file for finishing will cause this. For finishing use pure aluminum oxide or such, or wash in 10% nitrate acid.

C. C. MCLAREN, *Secretary*



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BRANCH NEWS

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NOTE TO SECRETARIES:

The mailing date for the REVIEW has, in the past, been somewhat irregular. The best interests of all are served by setting a mailing date and holding regularly to it.

In the future we will sincerely try to mail your REVIEW on the 10th of each month.

To realize this regular schedule we need your cooperation. Last forms must close on the 25th of the preceding month. Will you therefore be so guided and forward your reports promptly each month.

HARTFORD BRANCH

The regular meeting of the Hartford Chapter of the American Electroplaters Society was held at the Elk's Club in Bristol on January 18, 1943. Our speaker for the evening was Mr. Harry Sanders, supervisor of finishing at the North & Judd Manufacturing Company, New Britain, Conn. He gave an exceptionally interesting talk on "Government Specifications for the Finishing of Uniform Hardware." The talk was accompanied by interesting displays of various finishes.

It was brought out in the talk that there is great confusion among the various branches of the armed services and even between various quartermaster depots in the same service as to just what characterized a good finish. The various aspects of black nickel, oxidized copper, parkerizing with lacquering, zinc, cadmium, nickel, and silver plating were discussed. Even with the very rigid tests that are demanded of the most recent specifications it was pointed out that they can break down quite easily under the very severe conditions under which our troops are operating in various parts of the world.

Two movies were shown. First, "Russia Stops Hitler" was a resume of the first winter of Russia's fight with Germany and the second, "The Fight for Egypt" gave a lucid account of the actual conditions on the Egyptian front.

The applications of two new members were accepted. Mr. Harry Sanders of the North & Judd Manufacturing Company and Mr. Daniel Toce of the Hartford Chrome Company, Hartford, Conn.

Mr. Sanders was given a rising vote of thanks. The meeting was followed by refreshments consisting of beer and sandwiches.

K. P. BELLINGER, *Sec.-Treas.*

LOS ANGELES BRANCH

The first meeting of the New Year of the Los Angeles Branch was held at the Elks Club, 607 S. Parkview.

After a very excellent chicken dinner with no butter, the meeting was called to order by President E. R. Holman.

Minutes and financial reports were read and approved. Bills were ordered paid.

Sergt. at Arms Stanley Rynkofs introduced the following visitors: Mr. Fred Perry of the Aluminum Co. of America; Mr. Archie J. Peverley of National Supply Co.; Mr. Gilberth J. Vontz of National Supply Co.

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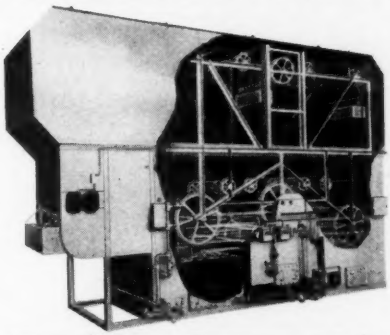

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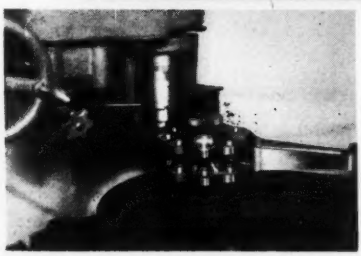

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Mr. Marcus Rynkofs, Chairman of the Dinner Dance Committee, reported that everything was going forward with plans for the best dinner dance ever held by the Los Angeles Branch. It will be held in March at the Elks Club, and those who are planning on attending were warned to make their reservations early to assure good tables as he has received 160 already.

Mr. Ervin Frauenhoff, Chairman of Membership, read three applications for membership which were voted on and turned over to Board of Managers. The applications received were: Archie J. Peverley, Associate, National Supply Co.; Gilberth J. Vontz, Associate; John L. Damon, Associate, of General Chemical Co.

The meeting was turned over to Librarian James ApRoberts, who gave a talk on "Problems and Methods for Plating on Magnesium", which was sent to the REVIEW.

Meeting adjourned at 10:30 P.M.

C. C. MCLAREN, *Secretary*

PHILADELPHIA BRANCH

Philadelphia Branch held is regular monthly meeting on its usual 4th Friday of the month, Jan. 22, 1943, at the Harrison Laboratory of the University of Pennsylvania, 34th and Spruce Sts., Philadelphia, Pa.

President Verrell opened the meeting with all officers present except 2nd Vice-President Del Robson.

The minutes of the previous meeting, as reported by Librarian Henry Orlik, were approved as read; with a vote of approval for the Librarian.

The applications of Frederick G. Stubbs, Active; George A. Taylor, Active; and Herman A. Miller, Associate, were referred to the Board of Managers.

The Board of Managers recommended the rejection of the application of George C. Brown, Active, and the Branch concurred.

The resignation of W. M. Swain, Associate, was accepted.

Motion — Philadelphia Branch concur in the action of Newark Branch in opposing the change in the name of the Supreme Society. Carried.

The Secretary was instructed to inform Newark Branch as to Philadelphia's inability to co-operate in the Tri-State Banquet.

Motion—the bills be paid. Carried.

Motion — the following members be suspended for non-payment of dues, namely, L. Abraham, H. Leroy Beaver, B. E. Burkhardt, Stanley Dumsha, J. R. Edwards, T. J. Fadgan, W. Gierman, James A. Good, John Mullins, R. G. Pitkin, Harold Reed, M. Reiher, E. H. Thompson, Francis Tray, Hiram A. G. Trout, and C. W. Wilson. Carried.

Due to being disappointed by the speaker, Librarian Orlik had a very intesting Question Box session with plenty of good questions.

PAUL MENTZER, *Secretary*

INDIANAPOLIS BRANCH

We were privileged to have with us Mr. H. H. Blouch, Electroplating Division, Dupont Corp.

Mr. R. T. Hennessey, President, opened the meeting and the speaker was introduced by Mr. Walter Binai, Librarian. Mr. Blouch gave a very interesting discussion on "Electroplating."

Mr. Blouch is very well known in the electroplating field and we had a very splendid turnout with eighteen for dinner and as many more who came in time for the business meeting.

Some of the high points in Mr. Blouch's discussion were electrical setup, motor generator setup, importance of keeping them clean. Fouled generators cause a lot of trouble.

(a) Stressed importance, under present conditions of anticipating requirements for 30, 60, 90 days in advance.

(b) Plan work and check supplies.

(c) Check water purification.

(d) Check metal scrap and other items pertaining to plating, keep accurate records of everything going into plating solutions.

(e) Keep constituents constant in order to maintain uniform results, keep plating solutions clean, avoid carryover of silica into plating solutions.

Mr. Blouch touched on zinc plating and had a few samples of ordinary hinges that had been zinc plated and bright dipped. Bright dipping zinc plated parts does not improve the finish, it actually dulls the finish. Lead, said the speaker is used more extensively today as a cor-

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rosion resistant metal than any other metal. It may be used more extensively after the war.

Light bulb bases that were, previous to the war, made of solid brass are now made of steel and given a light brass plating of 3/10,000 and hold up very well.

Speaker discussed three methods of brightening tin plate.

1. Palm Oil method.
2. Electrical.
3. Gas flame.

One of the most interesting was the hairpin electrical method of brightening tin plate where the electrical contact is made at the upper curve of the sheet and the lower half passes over a roller without current. I doubt if this method is entirely clear to all of us because it is hard to conceive that the electrical current does not continue throughout the sheet and not stop at each electrical contact.

Meeting adjourned at 10:00 P.M.

W. W. COTHRAN, *Sec.-Treas.*

DETROIT BRANCH

The holiday season and winter party being over, Detroit Branch settled down to the regular routine. The Branch held its January meeting at Hotel Statler on January 8th and listened to Mr. Thomas Cusack of C. M. Hall Lamp Co. His talk brought out the benefits which can be obtained by baking organic finishes by means of Infra Red Lamps. The saving in time and the improvements in the process were surprising to many of the members present. Mr. Cusack brought some slides along showing views of various installations now working successfully.

As an extra treat we were shown a movie entitled "World's Largest Electrical Workshop." The members present sat up and paid particular attention to the scenes showing building of generators.

Our February meeting will have Mr. E. W. Schweikher of E. I. duPont de Nemours & Co., as the speaker of the evening. His subject will be "The Sulfamate Lead Plating Process."

WRIGHT W. WILSON, *Acting Sec.-Treas.*

CLEVELAND BRANCH

Minutes of the meeting of the Cleveland Branch of the American Electroplaters Society held January 9, 1943, in the Cleveland Hotel.

The meeting was called to order at 8:30 by our president, Mr. William E. Oberg.

The minutes of the previous meeting were approved as read.

Under applications for membership the following names were submitted and then referred to the Board of Managers:

Ernest V. Collins of Cleveland, Ohio, as Active. Ben H. Brand of Cleveland, Ohio, as Active.

Mr. Joe Lechner of Cleveland, Ohio, whose application was published in the December, 1942 issue of *The Monthly Review*, was elected to Active Membership.

After some discussion it was decided to hold a a dinner dance at the Cleveland Hotel and Friday night, February 20 was tentatively selected. A committee comprising Messrs. J. Singler and Wm. Scott with Mr. Steve Miller as Chairman was appointed by the Chair to carry this affair through to a successful conclusion.

A letter was read from Mr. William F. Bruhns, President of the Newark Branch, New Jersey, in reference to the contemplated change in name and scope of the Society. There was some discussion on this with the entire matter being referred to Mr. J. Honnecker, Chairman of the committee appointed at the December meeting for that purpose.

The attention of the members was called to the joint meeting with the Cleveland Branch of The Electrochemical Society to be held in the Cleveland Hotel on January 18. The speaker scheduled is Dr. E. M. Baker, National President of The Electrochemical Society and "Chromium Plating" is the subject.

There being no further business to be brought before the members, the meeting adjourned.

GEORGE B. SVENSON, *Secretary*

ROCHESTER BRANCH

The meeting was called to order at 8:30 by President John Q. Adams.

The minutes of the previous meeting were read and approved and the financial report was read.

Mr. LoPresti, introduced Prof. Conley, of the University of Rochester, speaker of the evening. Prof. Conley spoke on "National Emergency Metals." He

(*Continued on Page 204*)

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Rectifiers for Electroplating, Anodizing and Electro-typing. Bulletin ER-103, issued by the Hanson-Van Winkle-Munning Co., Matawan, N. J., describes in full detail the HVWM copper oxide rectifiers, their construction, operation and operating characteristics, and also gives answers to a number of questions which come up in actual practice. These rectifiers are made in units ranging from 300 amp. to 2000 amp. at 6 v., and from 150 amp. to 1000 amp. at 12 v. Special rectifiers of larger sizes are also produced. The Bulletin is profusely illustrated with photographs, charts and diagrams which show clearly the principles and construction of this type of low-voltage current producing equipment.

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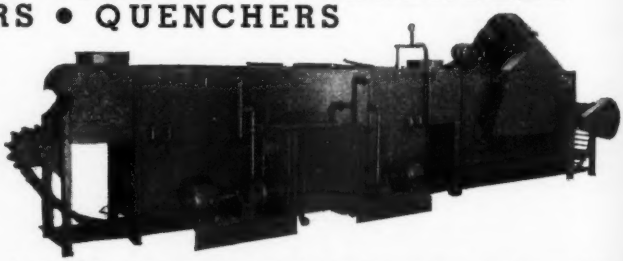

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J. B. FORD AND MICHIGAN ALKALI CONSOLIDATE AS WYANDOTTE CHEMICALS CORPORATION

The J. B. Ford Company and Michigan Alkali Company, its affiliate, have consolidated as one company to be known as Wyandotte Chemicals Coporation.

Mr. E. M. Ford, formerly a director of The J. B. Ford Company, is president of the new corporation. In his announcement he said the consolidation will entail no change in ownership nor will any new personnel be included in management.

The sales departments of both companies will temporarily maintain their separate identities as divisions of Wyandotte Chemicals Corporation, whose production is largely devoted to war effort and essential civilian needs.

The J. B. Ford Company was created in 1898. It has developed into the world's largest manufacturer of specialized cleaning materials, and an important factor in promoting sanitation and safe-guarding the health of America.

The Michigan Alkali Company, which is one of the largest producers of soda ash, caustic soda, chlorine, dry ice, calcium carbonate, bicarbonate of soda, and other chemicals used in virtually all industries, was established 52 years ago.

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U. S. STONEWARE CO. ANNOUNCES BULLETIN 498

The United States Stoneware Company of Akron, Ohio announce their latest bulletin, known as Laboratory Bulletin 498. This is a 12 page booklet attractively produced in color.

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Those desiring booklet 498 may obtain a copy by writing to the New York sales office at 60 East 42nd Street, New York, or to the company at Akron, Ohio.

showed slides and explained the structure, the heat treatment, the ductability and the stress points of National Emergency Metals; which contain mostly scrap and are coming into industry faster than we can realize. He distributed some valuable and interesting charts and analyses sheets on steel compositions, hardenability of national emergency steels, and hardening characteristics of common alloy steels.

We are indeed proud to have Prof. Conley as one of our fellow members of the Rochester Branch and we are indeed grateful and appreciate very much the timely and interesting evening he provided our members.

The meeting was adjourned at 10:45.

DONALD BLUM, *Secretary*

PITTSBURGH BRANCH

The regular meeting of the Pittsburgh Branch was held Thursday, January 7th, at the University Club.

A lengthy discussion on holding a dinner meeting resulted in the decision to hold the February meeting at 7:00 P.M. at the Fort Pitt Hotel. This should help those of our members who live out of town and cannot drive. The regular meeting will be held at 8:30 following the dinner.

Mr. Dimon of the Pittsburgh Branch gave a talk on "Electroforming" which was very well received. The discussion following his talk indicated the interest of those present in the subject.

Following the discussion on Electroforming, the Bell Telephone Company presented a film on the coaxial cable.

The meeting was adjourned at 10:15.

FRANK R. KELLER, *Sec.-Treas.*

CHICAGO BRANCH

The regular monthly meeting of Chicago branch was held Friday, Jan. 8, 1943, at the Atlantic Hotel.

President F. K. Savage presiding and all other officers present.

Frank Hanlon reported the illness of Mr. John Lockerbie who was operated on at the Presbyterian Hospital, John is improving and Chicago branch members extend their best wishes to Mr. Lockerbie. Mr. Hanlon also reported calling on Mr. O. E. Servis who also is improving in health. Frank also told about Mr. Jack Geisman of Milwaukee branch being ill, Jack is very well known to all Chicago branch members and we all hope these three members will soon regain perfect health, we surely miss them.

The application of Mr. A. A. Becker read and referred to a committee.

Mr. Mattacotti our Librarian introduced the speaker of the evening, Mr. W. Troyka, Asst. Supt. of the C. G. Conn, Ltd. of Elkhart, Indiana, who made a very interesting and instructive talk on "Foreman Training in War Industries." His talk will start all those members present thinking along the proper lines toward training our help to obtain greater production, with less rejects, less scrap and friction. Those interested in this course of instruction should get in touch with their local War Production Board.

There were 60 in attendance and the meeting adjourned at 10:45 P.M.

J. W. HANLON, *Secretary*

BUFFALO BRANCH

After a dinner at the Y, the members of the Buffalo branch assembled at the Hotel Statler for our January meeting of the 1943 Convention Committees. The meeting was called at 8:15 P.M. Friday, January 8th with President Ruff in the chair.

The letter from the Newark Branch regarding the proposed changes in the constitution was read by the secretary. All members expressed themselves as being in hearty accord with the ideas presented. It was also the consensus of opinion that it would be advantageous to have this letter published in *The Monthly Review*.

In the discussion that followed, concerning the status of members from allied fields, it was agreed that if the scope of the Society were to be enlarged it should include such persons as contribute directly to the advancement of the art of Electroplating. This would include chemists and technicians in charge of control, research and development in the electroplating field.

As an outcome of the above discussion, the following motion was presented by S. M. Johnson, seconded by Carl Kilroy and unanimously carried:

That the Buffalo branch go on record

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as advocating the adoption of a Constitutional amendment which would allow chemists and technicians in charge of control, research and development in the electroplating field to be accepted as active members of the Society and that a committee be appointed to draft such an amendment to be submitted at the next meeting of the Grand Society. President Ruff appointed Mr. Logan and Mr. Fotheringham as the committee to draft the above amendment.

It was decided to revise the committees for the National Convention in order to relieve some of the members who are too heavily burdened with war work to spare the necessary time. This was done by a round table discussion which included all members present.

The report of the Educational Committee indicated at least 14 papers already promised, including two on Government regulations on supplies and materials, anode coatings, organic finishes, tin plating strip steel, brass plating, chrome plating and others. With this impressive array of papers we should have an excellent convention with interesting and valuable material for every member.

The question came up as to the possibility of holding the 1943 Convention. Dr. Wernlund agreed to write the National Committee requesting them to get a ruling from the O. D. T. as soon as possible.

For the speaker at the Gumm Luncheon, the Committee is going to contact Joe Wesp, the Ironic Reporter, and Dr. Hodge of the U. of B. Round Table.

The meeting was adjourned at 10:00 P.M.

JAMES C. MAYS, *Secretary*

LANCASTER BRANCH

The Lancaster branch of the A.E.S. met Jan. 8th at the Stevens Trade School, at 8 P.M. There were 14 present.

The question of changing the name of the Society was brought up for discussion and action. After considerable discussion by all those present a motion was made, seconded and passed unanimously that the name of the Society remain unchanged. A second motion was made, seconded and passed that the Lancaster branch go on record of being in favor of widening the scope of the Society to include those engaged in other types of metal finishing.

It was voted that we cancel our Stag Party for February, due to the gasoline situation and have a technical meeting using some of our members as speakers.

After the conclusion of the business meeting the librarian introduced Mr. LeRoy Critchfield, of United Chromium and one of our own members who talked to us on "Organic Finishes."

Mr. Critchfield listed three major methods of producing a film by evaporation, oxidation and polymerization. The lacquers are examples of evaporation film producers and Mr. Critchfield described briefly the production of lacquers from natural gums and resins down to the latest cellulose derivatives.

The films produced by oxidizing are usually from paints containing a pigment, inert filler a vehicle and a colored pigment.

Mr. Critchfield finally discussed those materials producing films by polymerization. He stated that these materials must be used according to the specification for these materials to secure proper results. The various types of these coatings are the phenolic, urea and vinyls each type have specific advantages and uses. Mr. Critchfield closed his talk by stating that the proper film or coating should be chosen to meet the requirements of any particular job.

WILLIAM H. FORDNEY, *Sec. Treas.*

BOSTON BRANCH

Boston branch met Thursday, Jan. 7th, at the Statler Hotel, Boston, with Pres. Swift in the chair.

Minutes of the previous meeting read and approved.

Communications read and placed on file, bills read and moved they be paid.

Chairman Mintie made a report of the letter sent to Boston branch in regards to the changing of the name of the A.E.S., the final report will be made at the next meeting, the letter received from Newark branch was also turned over to the committee.

One application approved by the board of managers, Charles R. Culgin, 673 Washington Elms, Cambridge, Mass., was elected to membership.

There being no further business the chair was turned over to our librarian, Lou Gagnon. He had as the speaker for this meeting, Mr. Edward C. Rinker, Oakite Products Co., N. Y.

His subject was "Detergent Materials, Their Properties and Uses in Metal Manufacturing Plants."

He explained the method of cleaning different metals and slides. Also the time it took to clean the work before plating. He also answered all questions for the members and there were plenty.

A report of this talk will be sent to *The Review*. He was given a rising vote of thanks for his interesting talk.

Meeting adjourned at 10:15 P.M.

A. W. GARRETT, *Secretary*

ST. LOUIS BRANCH

The regular meeting of the St. Louis branch of the A.E.S. was held Monday, October 5th, 1942 at Central Y.M.C.A.

Dinner was served to 25 members after which President Musick called. There were no reading of minutes due to the fact the secretary forgot them.

One application was read to be acted on at our next meeting.

Letter read from Electro Chemical Society inviting the platers to attend their meeting in Detroit this month.

It was with regret that we read about the death of Mr. W. J. R. Kennedy. Our sympathy to Mrs. Kennedy.

There being nothing further, the meeting was turned over to our librarian, Professor R. M. Errington, who in turn introduced Mr. Stuart Krentel, representative of MacDermid, Inc., of Waterbury, Conn.

Stuart said Professor Errington called him up and asked him if he would give a talk at St. Louis. Stuart said what will I talk about. Professor said about 15 minutes. "So here I am. The subject will be 'Electro Plating in War Industry.'"

Mr. Krentel stated that there was plenty work in job shops as long as they could give deliveries and do quality work. Spoke of one small firm which was doing a large volume of work in jars, but was doing real quality work. Also spoke of bright copper plating in acid bath which was very interesting. Spoke of releasing the stress on springs by baking.

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Neither form of SURBRITE is a wetting agent. In acids, SURBRITE will not increase foaming tendencies. In some cases, such as big tanks with poor ventilation, a foam blanket might be helpful, mostly to save heat and reduce gas annoyance, but in all cases, controlling the pickling with SURBRITE is a major step in reducing acid fume annoyance.

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NEW ENGLAND REGIONAL MEETING

The Hartford chapter will be host to all the New England branches at the annual regional meeting to be held May 1, 1943 at the Bond Hotel, Hartford.

The committee is busy with plans for an interesting program which will be 100% defense.

ART LOCOZZO

Then Prof. Errington asked if there were any questions. There were some asked which Mr. Krentel answered to everyone's satisfaction. At this time, the MacDermid Co. was thanked for the talk by Mr. Krentel and also Professor Errington for making this talk possible.

Professor Errington is with the La Salco Co. of St. Louis. Motion made to give Mr. Krentel a rising vote of thanks.

Do not know the speaker for next meeting but you can be sure it will be good so put that down in the little black book. (2nd of Nov.)

Meeting adjourned.

CHARLES T. MCGINLEY, *Secretary*

GRAND RAPIDS BRANCH

Grand Rapids Branch held its regular meeting Jan. 8th, at the Browning Hotel, a large number of members and visitors attending.

The meeting was opened promptly at eight o'clock by the showing of sound pictures, one film entitled "America Can Give It." This film gave the story of the American War effort before and after Pearl Harbor. Another film entitled "Newscast of 1942" was also shown.

A short business session was then conducted by our President, Mr. Homer Morton, who called upon the visitors to be introduced and at this time three applications for membership were received.

The speaker, Mr. L. R. Davidson of the Sturgis Products Company was then introduced and his subject, "Barrel Deburring and Finishing" was warmly received by all present. Mr. Davidson gave us a very extended talk on practical applications which described the new method of deburring and polishing and finishing by the barrel process. A number of questions were asked and answered by Mr. Davidson, and a discussion took place as to the different methods used with the new barrel processing equipment.

The Librarian then conducted the Question Box and questions were answered by round table discussion by three members including Mr. Davidson.

Refreshments were then served to all present and the meeting was adjourned.

C. E. ABEL, *Sec.-Treas.*

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1943 Convention News

To Members and Friends of the A.E.S.:

You-all have no doubt been wondering what, if anything, the Buffalo branch has been doing about the 1943 A.E.S. convention this June 7, 8 and 9. The answer is,—plenty. Briefly, here in part, is the score,—

1. Practically all of the facilities of the Statler Hotel in Buffalo have been engaged for the period of June 6, 7, 8 and 9.
2. The Program Committee has been on the job. We can promise you well over a dozen first class papers and we are reasonably sure of at least 16. Among these are papers covering modern methods of tin plating steel strip, High Speed Silver plating, modern brass plating, the finishing of aluminum and magnesium (1943 style), chromium plating, the disposal of waste cyanide solution, etc., etc.
3. The Entertainment Committee is arranging for some super-duper entertainment for all you boys, your wives and sweethearts. This committee has some very unusual talent in its membership and some really high-brow connections. There just isn't going to be a dull minute while you are at this meeting—even the midnight shift is being looked after in a big way, no kidding. If you do not believe this ask Dave Clarin.
4. Dr. William Blum of the National Bureau of Standards has promised to bring us up to the minute as concerns the war problems. We also are planning to have Messrs. McCord and George Hogaboom, Sr., round out the war picture as concerns our Government's plan for us electroplaters.
5. The Ex-Committee of our Supreme Society is right now putting its shoulders to the wheel as regards the problem of securing permission from the O.D.T. to hold our annual convention this June in Buffalo as planned. You can rest assured they will leave no stone unturned to keep the Society's record for annual conventions unbroken. RIGHT NOW PROSPECTS FOR THE 1943 BUFFALO A.E.S. ANNUAL CONVENTION ON JUNE 7, 8 AND 9 APPEAR EXCELLENT. (More definite, detailed information will be published in your review next month.)

Yours for an A-A-A-1 Convention.

DR. C. J. WERNLUND, General Chairman

1943 A.E.S. Convention Committee.

TORONTO BRANCH

The regular meeting of the Toronto Branch was held at the Royal York Hotel on January 8th with a good attendance. President Boaz in the Chair, opened the meeting by introducing Mr. Reisenberg of the Lea Products Manufacturing Co., and member of the Montreal Branch of the A.E.S. All officers were present except Trustee Johnston.

A letter was read from Mr. W. F. Bruhns, President of the Newark Branch. This letter will go before the Executive Board for careful study and recommendation.

The Boaz Byers Harris & Fitzsimmons outfit got busy with their report of the Electroplaters dance to be held in the Sunnyside Boulevard Pavilion February 12th. This Committee is a live one and this grand affair is sure to be successful. Mr. Reisenberg was then called. His subject being, "Polishing With Abrasive Grain." The speaker started with six samples of abrasives on exhibit and gave each a test for capilory quality showing good and poor and explaining what each was expected to do, and what the results would be with each sample. He used the blackboard for illustrations and drawings of the different abrasives from quartz; silica carbide; natural corundum; boron carbide; and diamond dust; grinding of the different metals including eye glasses; to finding fault in the polishing room, with the application of glue on polishing wheels, he told how to do it and why, giving time of drying on canvas and felt, the mixing of glue to the right consistency, such as less water for large grains and more water for fine grains: Example, 150 grain 30% glue 70% water, 240 grain, 25% glue 75% water, stating whether Hide glue or cement are used to buy the best regardless of cost. This talk started a discussion that was hard to stop. Mr. Reisenberg answered many questions and in the discussion the suggestions were varied such as how to keep greaseless compound when not in use. For this purpose one member suggested damp sawdust.

Mr. Reisenberg received a hearty vote of thanks from the members and was asked to come again.

Meeting adjourned 10:45.

JAMES S. CAIRNS, *Secretary*

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BUY WAR BONDS

A LETTER TO THE MEMBERS

Mr. Charles H. Proctor, the Founder of our Society, has just recently passed away, but his memory will live with us forever.

Last June at Grand Rapids, Michigan, an amendment to our Constitution to change the name and enlarge the scope of the Society was presented and discussed thoroughly. This amendment was finally defeated, primarily due to the fact that the name of the Society was to be changed. The new name would have been the American Electroplaters and Metal Finishers Society. The fact that "Metal Finishers" would cover a large field by including polishers, buffers, grinders, automobile painters and many others, contributed to its defeat. It was recommended, however, that the ensuing President appoint a committee to reconsider and further investigate the prospects of this amendment so that it could be brought before the next Convention for further action. Letters have been mailed to the Secretaries of all Branches to be read at their meetings and the discussions and decisions are to be reported to Ellsworth Candee, Chairman of the Committee. It is hoped that all the Branches will report promptly. This would enable the Committee to obtain a general consensus of opinion. It is still the feeling of most of our members that the name of the Society should not be changed and, therefore, this point should be very carefully debated by all members. We all know that the Society was organized in 1909 and reorganized in 1913 under its present name, since which time it has grown from a small group to its present membership of 2,897. The records indicate that the membership has increased every year and we hope it will continue for many years to come.

Never before, in the history of this nation, has the opportunity presented itself to the A.E.S. to serve the nation as a body. Let us put the united weight of our entire membership behind the nation to help win the war. Let us not criticize our Government for restricting the use of strategic metals such as nickel, copper, cadmium and many others to certain limited items. Substitutes in many cases have proven to be very satisfactory and some of them will be used long after this war is over. Speakers at our various Branch meetings are doing their utmost to enlighten our members as to the changes which are rapidly taking place.

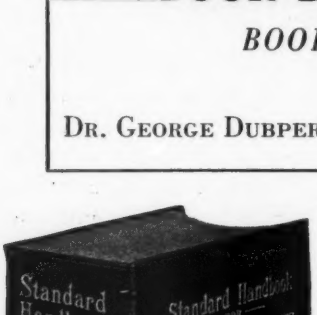
First Vice President
GEORGE WAGNER

BOOK DEPARTMENT

BOOK REVIEWS

By

DR. GEORGE DUBPERNELL, *United Chormium, Inc.*



Standard Handbook for Electrical Engineers. Edited by A. E. KNOWLTON and R. M. SHOOK. 7th Edition, 2303 pages, 1941. Published by McGraw-Hill Book Company, New York, price $8.00.

This book was described briefly in the January *Review*. It consists of twenty-six main sections which are divided into numerous subsections written by a staff of about one hundred specialists. The individual paragraphs of each main section are numbered to facilitate reference. The book is well indexed but the page numbers are not given; instead reference is made to the section number and paragraph number. The main sections have a thumb-nail guide which facilitates the use of this system when one becomes accustomed to it.

This handbook appears to be a tremendous collection of information on all phases of electrical engineering, in view of its relatively low price. Some data can be found in it on any subject connected with electricity. The information given is very clearly presented, with a liberal use of charts, drawings, and tables. The subjects of the main sections are as follows: Units and Conversion Factors, Electric and Magnetic Circuits, Measurements, Properties of Materials, Circuit Elements, Transformers, Regulators and Reactors, Alternating-current Generators and Motors, Direct-current Generators and Motors, Rectifiers and Converters, Prime Movers, Power Plant Economics, Power System Electrical Equipment, Power Transmission, Power Distribution, Industrial Power Applications, Electric Heating and Welding, Electricity in Transportation, Electrochemistry and Electrometallurgy, Wiring Design, Illumination, Batteries, Wire Telephony and Telegraphy, Electronics and Electron Tubes, Radio and Carrier Communication, Codes and Standard Practices, Electrophysics.

While the book is primarily designed for reference purposes for electrical engineers, it is also of considerable value to those concerned with the plating and finishing field. The constants which one needs to refer to a handbook for are substantially all here, and in addition a diversity of information in a variety of fields. For example, the section 4 on Properties of Materials is 242 pages long, and includes Metals and nonmetals, metallurgy and insulating materials or varnishes; the review of plastics is brief but excellent. The sections on d. c. dynamos, rectifiers and batteries are all of direct interest to platers. Each chapter includes a bibliography. The section on Electroplating was written by G. A. Roush and revised by J. V. Alfriend, Jr. It extends from page 1930 to page 1941, and is followed by one on the electrolytic refining of metals. It is of course not possbile to give a complete and up-to-date description of present day plating in such a short article, but the more important processes are described and clearly defined. The basic principles of cleaning and plating operations are also given. The elements of electrochemistry are also reviewed in the first part of Section 20.

Cleaning and Finishing Metal Products. Published by The Iron Age, New York, 1942, 235 pages, price $3.00.

This book was listed in last month's *Review*. It contains reprints of forty articles which have appeared from time to time in the Iron Age. The articles are well reproduced, but are not identified as to when they appeared originally. There is a table of contents giving titles of articles but not authors, and no index. Many of the papers are of high quality and contain much helpful information. It is a worthwhile convenience to be able to obtain them separately for a nominal price. The complete list of articles and authors is as follows:

Cleaning of Metallic Surfaces, C. B. F. Young, pages 1-15; Electric Cleaning of Metals, C. C. Hermann and R. W. Mitchell, pages 16-19; Metal Cleaning, W. F. Sherman, pages 20-22; Hydrogen Embrittlement, H. J. Noble, pages 23-30; Wrinkle Finish, page 31; Protecting Steel Against Corrosion, J. C. Hudson, pages 32-35; Ball Burnishing, F. T. Mann, pages 36-39; Fixed Burnishing, W. H. Young, pages 40-43; Electrolytic Polishing of Stainless Steel, four articles, by T. W. Lippert, pages 44-48, G. Kiefer, pages 60-63, H. Pray and C. L. Faust, pages 64-68, and S. Tour, pages 69-78; Polishing Stainless Steel, W. M. Mitchell, pages 49-59; Selecting the Proper Coating, G. Soderberg, pages 79-81; Nickel Plate, A. Bergman, pages 82-85; Electroplating on Aluminum, A. Bregman, pages 86-88; Buffing Before Plating to Improve Rust Resistance, E. G. Coffey and L. Borchert, pages 89-91; Placing a Plating Contract, ananymous, pages 92-93; Specification Plating, C. B. F. Young, pages 94-104; Cadmium Plating, A. Bregman, pages 105-109; Cadmium Plating in the Victory Program, A. J. Fusco and N. E. Woldman, pages 110-116, Rhodium Plating, A. Bregman, pages 117-119; Metal Finishing Costs, A. Bregman, pages 120-127; Plating Alloys, C. B. F. Young, pages 128-135; Hot Galvanizing, A. T. Baldwin, pages 136-139; Plastic-on-Metal Finishes, anonymous, pages 140-142; Plating Metals on Non-Metals, A. Bregman, pages 143-151; Silver to Replace Nickel and Chromium Plate, A. Bregman, pages 152-159; Silver Plating Technique, A. Bregman, pages 160-170; Lead and Tin Undercoats for Silver Plating, A. Bregman, pages 171-176; Sprayed Metal, A. B. Tickle, Jr., pages 177-180; Coloring of Metals (four articles), H. R. Simonds and C. B. F. Young, pages 181-204; Color in Industry, H. R. Simonds, pages 205-212; Preparation for Paint (parkerizing, etc.), anonymous, pages 212-219; Enameling and Lacquering, H. R. Simonds, pages 220-224; Rectifiers in Hard Chrome Plating, J. C. Bogle, pages 225-227; Pre-Finished Raw Materials, H. R. Simonds, pages 228-231; Finishing Room Control; L. W. Lammiman, pages 232-235.

A.E.S. BOOK DEPARTMENT

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Chairman, Membership Committee

To January, 1943

ELECTIONS

Baltimore-Washington Branch

HARRY CLIFFORD GRANT, JR.—Cummins & Grant, 9 N. Eutaw St., Baltimore, Md., Associate
RICHARD J. NORRIS—U. S. Naval Gun Factory, Associate
STANLEY P. WATKINS—Rustless Iron & Steel Corp., Associate

Boston Branch

CHARLES R. CULGIN—General Radio Co., 30 State St., Cambridge, Mass., Active

Chicago Branch

R. J. BILBO—1045 N. Lawndale Ave., Chicago, Ill., Active
S. G. ENGLUND—1314—13th St., Rockford, Ill., Associate
G. P. DOPPKE—4247 W. Hirsch St., Chicago, Ill., Associate
T. H. WESTBY—c/o Sears Roebuck & Co. (Dept. 817), Chicago, Ill., Associate
V. PLESSCHER—c/o The National Research Bureau, Inc., Associate
W. P. COLEMAN—5232 N. Rockwell St., Chicago, Ill., Associate

Cleveland Branch

JOE LECHNER—9706 Steinway Ave., Cleveland, Ohio, Active

Dayton Branch

FRANK H. SCHLADEN—604 Berkley Road, Columbus, Ohio, Associate
KEITH W. NETZLEY—P.O. Box, Ithaca, Ohio, Associate

Detroit Branch

ALFRED L. FERGUSON—Chem. Lab., University of Michigan, Ann Arbor, Associate
PAUL JACKSON—1249 Holden Ave., Detroit, Mich., Associate
EDWIN DENBY—11613 Mack Ave., Detroit, Mich., Active
SEYMOUR SENDEROFF—2294 Cortland Ave., Detroit, Mich., Associate
GEORGE J. KUNKEL—3000 Greyfriars, Detroit, Mich., Active
LAWRENCE W. HIGGINS—4693 Cornell, Dearborn, Mich., Active

Indianapolis Branch

WALTER GULLISON—Lukas-Harold Corp., Active
CARL RICHARD MORRIS—Allison Division of G. M. C., Associate
ALBERT E. PRITCHARD—Lukas-Harold, Associate
QUENTIN O. SHOCKLEY—Allison Division of G. M. C., Associate

Philadelphia Branch

I. WILLIAM MARCOVITCH—R.C.A. Mfg. Co., Inc., Associate

Waterbury Branch

CLYDE D. MICHAELS—Asst. Supt., Tinning Dept., Fairfield Tin Mill, Fairfield, Ala., Associate

APPLICATIONS

Chicago Branch

A. A. BECKER—705 Wisconsin St., Oak Park, Ill., Associate

Cleveland Branch

ERNEST V. COLLINS—Active BEN H. BRAND—Active

Detroit Branch

THOS. K. CHRISTIANSON—322 Eason Ave., Highland Park, Mich., Associate
CHARLES M. COOK—17366 Appoline, Detroit, Mich., Associate
JOHN F. COSSEY—11227 Elmdale, Detroit, Mich., Active
JAMES M. FLAHERTY—Michigan Chrome & Chemical Co., Detroit, Mich., Active
ROBERT GILBERT—5488 Horger St., Dearborn, Mich., Active
GEORGE HOTALA—c/o Detroit Hardware Mfg. Co., Detroit, Mich., Active
KLASS KNIBBE—Knibbe Mfg. Co., 16941 Lilac, Detroit, Mich., Active
W. A. NELSON—816 Washington Rd., Grosse Pointe, Mich., Associate
DAVE REILSON—556 Sheridan Ave., Detroit, Mich., Active
ANDREW V. RI—664 W. Palmer, Detroit, Mich., Active
BERNARD J. ROSE—2365 Casmere, Detroit, Mich., Associate
ALFRED F. SAYERS—2517 Blaine Ave., Detroit, Mich., Associate
HOWARD A. TALBERT—R.R. 2, Perry, Mich., Associate
CLARENCE J. WEINE—17325 Strasburg, Detroit, Mich., Active

Indianapolis Branch

JEWELL PAUL VERNON—2168 N. Capitol Ave., Indianapolis, Ind., Associate
THOMAS CHARLES O'NAN—545 Fletcher Ave., Indianapolis, Ind., Associate
BERNARD H. SCHOCH—1026 N. Garfield Dr., Indianapolis, Ind., Associate

Philadelphia Branch

FREDERICK G. STUBBS—Philadelphia, Active
GEORGE A. TAYLOR—Philadelphia, Active
HERMAN A. MILLER—Philadelphia, Associate

Springfield Branch

DANIEL CANZINO—25 Massachusetts Ave., Pittsfield, Mass., Associate
DR. CESAR ROITMAN—Avda. de Mayo, 1302-Bs. As. Argentina, Associate

FREDERICK G. WEBER—9 Federal St., Springfield, Mass., Associate
DONALD ISACS—Winna Motor Products, 112 Redfern St., N.S.W., Australia, Active

TRANSFERS

FLOYD ERIENMEYER—from Newark to Bridgeport
WALTER J. MANSON—from Detroit to New York
ROMAN C. BINDER—from Milwaukee to Grand Rapids
ARTHUR LOGOZZO—from Springfield to Hartford
W. J. ROBINSON—from Springfield to Hartford
A. NORMAN SERLES—from Springfield to Schenectady

RESIGNATIONS

Bridgeport Branch

FRED R. GRIFFITH

Detroit Branch

E. J. FINNIE	H. L. MILLER	H. C. STEINMEYER
T. N. GASSEN	K. W. RULE	HUBB BELL
J. F. HERR	E. W. SKELTON	JOSEPH CLARK
L. J. KEENAN	DONALD SPENGLER	W. H. DAVIS
B. A. KIRBY	J. N. BOURG	HARVEY C. DEIKE

Milwaukee Branch

H. A. PINKALLA JOHN A. MAIER

Philadelphia Branch W. M. SWAIN

Pittsburgh Branch J. C. LEUTWYLER, JR.

CHANGE IN STATUS

Toledo Branch

DANIEL WILCZYNSKI and CHARLES YOUNG—(in U. S. Service), Reinstated

SUSPENSIONS

Los Angeles Branch

JAMES BERSANO	WESLEY RIES
FLOYD M. CAMPBELL	WILLARD R. SCHULER
MABRY C. CORTNEY	RALPH R. WILDE
JOSEPH J. KRAHULIK	

Philadelphia Branch

L. ABRAHAM	T. J. FADGAN	M. REIHER
H. LEROY BEAVER	W. GIERMAN	E. H. THOMPSON
B. E. BURKHARDT	JAMES A. GOOD	FRANCIS TRAY
STANLEY DUMSHA	JOHN MULLINS	HIRAM A. G. TROUT
J. R. EDWARDS	R. G. PITKIN	C. W. WILSON
	HAROLD REED	

DEATHS

JOHN W. MURRAY—Springfield, Mass.
R. J. LATTIMER—Detroit, Mich.

MEMBERSHIP CHART

BRANCH	May 1942	Change in Membership	Percent Change
CINCINNATI	42	+13	+30.9
CLEVELAND	81	+19	+23.5
INDIANAPOLIS	48	+10	+20.8
BALT.-WASHINGTON	82	+15	+18.3
MONTREAL	44	+ 6	+13.6
SYRACUSE	31	+ 4	+12.9
NEWARK	156	+16½	+10.8
TORONTO	87	+ 7	+ 8
ROCHESTER	80	+ 5	+ 6.3
CHICAGO	258	+16	+ 6.2
WATERBURY	97	+ 5	+ 5.2
PITTSBURGH	52	+ 2	+ 3.8
BUFFALO	55	+ 2	+ 3.6
SAN FRANCISCO	46	+ 1	+ 2.2
PROV.-ATTLEBORO	49	+ 1	+ 2
BINGHAMTON	16	+ 0	+ 0
LANCASTER	44	— 1	— 2.3
NEW HAVEN	105	— 2½	— 2.4
BOSTON	118	— 3	— 2.5
DAYTON	99	— 3	— 3
BRIDGEPORT	80	— 2½	— 3.1
MILWAUKEE	97	— 3½	— 3.6
HARTFORD	67	— 2½	— 3.7
NEW YORK	139	— 5½	— 3.9
LOS ANGELES	128	— 5	— 3.9
SPRINGFIELD	72	— 3	— 4.1
ST. LOUIS	82	— 4	— 4.8
GRAND RAPIDS	87	— 5½	— 6.3
DETROIT	277	—18½	— 6.7
PHILADELPHIA	142	—14	— 9.9
ANDERSON	38	— 4	—10.5
TOLEDO	46	— 8	—17.4

MEMBERSHIP – May 1st, 1942 = 2845
MEMBERSHIP – FEB. 1st, 1943 = 2877
GAIN IN MEMBERSHIP 32
Percent of Gain = 1.1%

BUYERS' GUIDE

ABRASIVES

Harrison & Co., Haverhill, Mass.
Lasalco, Inc., St. Louis, Mo.
Lea Mfg. Co., Waterbury, Conn.
Norton Company, Worcester, Mass.
Roberts Rouge Co., Stratford, Conn.

ACTIVATED CARBONS

Darco Corporation, New York City
Industrial Chemical Sales, New York City

ALKALI CLEANING COMPOUNDS

Detroit Rex Products Co., Detroit, Mich.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.
MacDermid, Inc., Waterbury, Conn.
Magnus Chemical Co., Garwood, N. J.
Magnuson Products Corp., Brooklyn, N. Y.
Oakite Products Inc., New York City
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.
Wyandotte Chemicals Corp., Wyandotte, Mich.

ANODES, ACIDS AND SALTS

Apothecaries Hall Co., Waterbury, Conn.
du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Harshaw Chemical Co., The, Cleveland, Ohio
Lasalco, Inc., St. Louis, Mo.
Preciment Laboratories, New York City
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

ANODES, ACIDS AND SALTS

Stevens, Frederic B., Inc., Detroit, Mich.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.

ANODES—CHROMIUM PLATING

Hanson-Van Winkle-Munning Co., Matawan, N. J.
Harshaw Chemical Co., The, Cleveland Ohio
Heil Engineering Company, Cleveland Ohio
Lasalco, Inc., St. Louis, Mo.
McGean Chemical Co., Cleveland, Ohio
Seymour Mfg. Co., Seymour, Conn.
Stevens, Frederic B., Inc., Detroit, Mich
Storts Welding Co., Meriden, Conn.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.
United States Stoneware Co., The, Akron, Ohio.

ANODES—COPPER

American Brass Co., Waterbury, Conn.
du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Harshaw Chemical Co., The, Cleveland, Ohio
Lasalco, Inc., St. Louis, Mo.
McGean Chemical Co., Cleveland, Ohio
Seymour Mfg. Co., Seymour, Conn.
Stevens, Frederic B., Detroit, Mich.
Stutz, George A. Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.

ANODES—ELECTRIC CLEANER

Lasalco, Inc., St. Louis, Mo.
Storts Welding Co., Meriden, Conn.
Stutz, George A., Mfg. Co., Chicago, Ill.

BUYERS' GUIDE

ANODES—NICKEL

Seymour Mfg. Co., Seymour, Conn.

ANODES—ZINC

du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Harshaw Chemical Co., The, Cleveland, Ohio
Lasalco, Inc., St. Louis, Mo.
Meaker Company, The, Chicago, Ill.
Seymour Mfg. Co., Seymour, Conn.
Stevens, Frederic B., Inc., Detroit, Mich.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.

BALL ANODES

du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.

BUFFS AND BUFFING COMPOSITIONS

Advance Polishing Wheels, Inc., Chicago, Ill.
Apothecaries Hall Co., Waterbury, Conn.
Burns, E. Reed, Corp., Brooklyn, N. Y.
Divine Brothers Co., Utica, N. Y.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Harrison & Co., Haverhill, Mass.
L'Hommedieu, Chas. F., & Sons, Co., Chicago, Ill.
Lasalco, Inc., St. Louis, Mo.
Lea Mfg. Co., Waterbury, Conn.
MacDermid, Inc., Waterbury, Conn.
Matchless Metal Polish Co., Glen Ridge, N. J., and Chicago, Ill.
Puritan Mfg. Co., Waterbury, Conn.
Roberts Rouge Co., Stratford, Conn.
Stevens, Frederic B., Detroit, Mich.

BUFFS AND BUFFING COMPOSITIONS

Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.
United Laboratories, Linden, N. J.

BURNISHING BARRELS AND BALLS

Abbott Ball Co., Hartford, Conn.
Baker, M. E., Co., Cambridge, Mass.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.
Magnuson Products Corp., Brooklyn, N. Y.
Storts Welding Co., Inc., Meriden, Conn.

BURNISHING COMPOUNDS

Ford, J. B., Co., The, Detroit, Mich.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
Lasalco, Inc., St. Louis, Mo.
Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York City

CADALYTE PLATING MATERIALS "CARBONATE REMOVER"

du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Lasalco, Inc., St. Louis, Mo.

CADMIUM SERVICE

Hanson-Van Winkle-Munning Co., Matawan, N. J.
Udylte Corp., The, Detroit, Mich.

CADUX MATERIALS

Hanson-Van Winkle-Munning Co., Matawan, N. J.

CEMENT—GLUE SUBSTITUTE

Harrison & Co., Haverhill, Mass.

BUYERS' GUIDE

CEMENT POLISHING WHEEL

Harrison & Co., Haverhill, Mass.
Lasalco, Inc., St. Louis, Mo.
Lea Mfg. Co., The, Waterbury, Conn.

CHROMIUM SERVICE

Hanson-Van Winkle-Munning Co., Matawan, N. J.
United Chromium, New York City

CLEANERS AND CHEMICALS

Apothecaries Hall Co., Waterbury, Conn.
Detroit Rex Products Co., Detroit, Mich.
du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Enthone Co., New Haven, Conn.
Ford, J. B., Co., Wyandotte, Mich.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Harshaw Chemical Co., The, Cleveland, Ohio
Lasalco, Inc., St. Louis, Mo.
Lea Mfg. Co., The, Waterbury, Conn.
MacDermid, Inc., Waterbury, Conn.
Magnus Chemical Co., Garwood, N. J.
Magnuson Products Corp., Brooklyn, N. Y.
McGean Chemical Co., The, Cleveland, Ohio
Meaker Company, The, Chicago, Ill.
Merck & Co., Inc., Rahway, N. J.
Norton Co., Worcester, Mass.
Oakite Products, Inc., New York City
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.
Puritan Mfg. Co., Waterbury, Conn.
Stevens, Frederic B., Inc., Detroit, Mich.
Sulphur Products Co., Greensburg, Pa.
Udylte Corp., The, Detroit, Mich.
Zialite Corporation, Mt. Vernon, N. Y.

COILS—PLATING TANKS

Heil Engineering Company, Cleveland, Ohio
Lasalco, Inc., St. Louis, Mo.
Storts Welding Co., Meriden, Conn
United States Stoneware Co., The, Akron, Ohio.

DEGREASERS

Blakeslee, G. S., & Co., Chicago, Ill.
Detroit Rex Products Co., Detroit, Mich.
Mechanical Process, South Orange, N. J.
Phillips Mfg. Co., Chicago, Ill.

EQUIPMENT

Alsop Engineering Corp., Milldale, Conn.
Blakeslee, G. S., & Co., Chicago, Ill.
Ceilcote Company, Cleveland, Ohio
Detroit Rex Products Co., Detroit, Mich.
Divine Brothers Co., Utica, N. Y.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
Hammond Machinery Builders, Kalamazoo, Mich.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Heil Engineering Co., Cleveland, Ohio
Industrial Filter & Pump Mfg. Co., Chicago, Ill.
Lasalco, Inc., St. Louis, Mo.
Lea Mfg. Co., The, Waterbury, Conn.
L'Hommedieu, Chas. F., & Sons Co., Chicago, Ill.
Meaker Co., The, Chicago, Ill.
Mechanical Process Company, South Orange, N. J.
Miller, J. C., Company, Grand Rapids, Mich.
Paasche Airbrush Company, Chicago, Ill.
Packer Machine Co., The, Meriden, Conn.
Phillips Mfg. Co., Chicago, Ill.
Stevens, Frederic B., Inc., Detroit, Mich.
Storts Welding Co., Meriden, Conn.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.
United Laboratories, Linden, N. J.
United States Stoneware Co., The, Akron, Ohio.

LEAD LINED TANKS

Hanson-Van Winkle-Munning Co., Matawan, N. J.
Heil Engineering Company, Cleveland, Ohio
Lasalco, Inc., St. Louis, Mo.
Storts Welding Co., Meriden, Conn.
Udylite Corp., The, Detroit, Mich.
United States Stoneware Co., The, Akron, Ohio.

BUYERS' GUIDE

MEAKER PROCESS GALVANIZING

Meaker Company, The, Chicago, Ill.

METAL LACQUERS AND FINISHES

Alrose Chemical Co., Providence, R. I.
Atlas Powder Co., Zapon Div., Stamford, Conn.
Egyptian Lacquer Mfg. Co., New York City
Heatbath Corporation, Springfield, Mass.
Maas & Waldstein Co., Newark, N. J.
New Wrinkle, Inc., Dayton, Ohio
Preciment Laboratories, New York City

METAL WORKING LUBRICANTS

Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York City

OXIDIZING AGENTS

Lasalco, Inc., St. Louis, Mo.
Mitchell-Bradford Chemical Co., Bridgeport, Conn.
Puritan Mfg. Co., Waterbury, Conn.
Sulphur Products Co., Greensburg, Pa.

PLATING BARRELS

Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.
Lea Mfg. Co., The, Waterbury, Conn.
Stevens, Frederic B., Inc., Detroit, Mich.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.

PLATING TANKS

Hanson-Van Winkle-Munning Co., Matawan, N. J.
Heil Engineering Company, Cleveland, Ohio
Lasalco, Inc., St. Louis, Mo.
Stevens, Frederic B., Inc., Detroit, Mich.
Storts Welding Co., Meriden, Conn.

PLATING TANKS

Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.
U. S. Stoneware Co., New York City

POLISHING LATHES

Baker, M. E., Co., Cambridge, Mass.
Divine Brothers Co., Utica, N. Y.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
Hammond Machinery Builders, Kalamazoo, Mich.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.
L'Hommedieu, Chas. E., & Sons Co., Chicago, Ill.
Stevens, Frederic B., Detroit, Mich.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.

PLATING—PRECIOUS METALS

Baker & Co., Inc., Newark, N. J.
Merck & Co., Rahway, N. J.
Spectranome, New York City

POLISHING WHEELS AND MATERIALS

Advance Polishing Wheels, Inc., Chicago, Ill.
Baker, M. E., Co., Cambridge, Mass.
Burns, E. Reed, Brooklyn, N. Y.
Divine Brothers Co., Utica, N. Y.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.
L'Hommedieu, Chas. E., & Sons Co., Chicago, Ill.
Matchless Metal Polish Co., The, Glen Ridge, N. J., and Chicago, Ill.
Miller, J. C., Co., Grand Rapids, Mich.
Puritan Mfg. Co., Waterbury, Conn.
Roberts Rouge Co., Stratford, Conn.
Stevens, Frederic B., Detroit, Mich.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.
United Labortories, Linden, N. J.

BUYERS' GUIDE

ROUGES

Hanson-Van Winkle-Munning Co., Matawan, N. J.
Harrison & Co., Haverhill, Mass.
Lasalco, Inc., St. Louis, Mo.
Matcheless Metal Co., Glen Ridge, N. J.
Roberts Rouge Co., Stratford, Conn.
Stevens, Frederic B., Detroit, Mich.
Udylite Corp., The, Detroit, Mich.

RUBBER-LINED TANKS

Heil Engineering Co., Cleveland, Ohio
Lasalco, Inc., St. Louis, Mo.
Storts Welding Co., Meriden, Conn.
United States Stoneware Co., The, Akron, Ohio.

SOAPS

Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lea Mfg. Co., The, Waterbury, Conn.
MacDermid, Inc., Waterbury, Conn.
Magnus Chemical Co., Garwood, N. J.
Magnuson Products Corp., Brooklyn, N. Y.
Oakite Products, Inc., New York City
Udylite Corp., The, Detroit, Mich.

SOLUTION CONTROL METHODS

du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Hanson-Van Winkle-Muning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.

SOLVENTS—DEGREASING

Detroit Rex Products Co., Detroit, Mich.
Lasalco, Inc., St. Louis, Mo.
Lea Mfg. Co., The, Waterbury, Conn.
MacDermid, Inc., Waterbury, Conn.
Magnus Chemical Co., Garwood, N. J.
Mechanical Process Co., South Orange, N. J.
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.
Phillips Mfg. Co., Chicago, Ill.

SOLVENTS—DEGREASING

Westvaco Chlorine Products Corp., New York, N. Y.

STRIPPING COMPOUNDS

Detroit Rex Products Co., Detroit, Mich.
du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
MacDermid, Inc., Waterbury, Conn.
Magnus Chemical Co., Garwood, N. J.
Magnuson Products Corp., Brooklyn, N. Y.
Oakite Products, Inc., New York City

TESTING INSTRUMENTS

American Instrument Co., Silver Spring, Md.
du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Harshaw Chemical Co., The, Cleveland, Ohio
Industrial Filter & Pump Mfg. Co., Chicago, Ill.
Kocour Co., Chicago, Ill.
Lasalco, Inc., St. Louis, Mo.

TUMBLING BARRELS

Abbott Ball Co., Hartford, Conn.
Baker, M. E., Co., Cambridge, Mass.
Lasalco. Inc., St. Louis, Mo.
Storts Welding Co., Meriden, Conn.

UDYLITE CADMIUM SERVICE

MacDermid, Inc., Waterbury, Conn.
Udylite Corp., The, Detroit, Mich.

USED EQUIPMENT

Baker, M. E., Co., Cambridge, Mass.

WASHERS—METAL PARTS

Blakeslee, G. S., & Co., Chicago, Ill.
Detroit Rex Products Co., Detroit, Mich.

BRANCH DIRECTORY

ANDERSON meets second Tuesday of every month at 7:30 p.m., at the Y. M. C. A. Anderson, Indiana. Secretary-Treasurer, E. L. McKinney, 2014 Fairview St., Anderson, Ind.

BALTIMORE-WASHINGTON meets at the Telford Buffeteria, 14th and Decatur Sts., N.W. Washington, D. C., the first Saturday of each month. Secretary-Treasurer, Abner Brenner, 6509 Fulton St., Chevy Chase, Md.

BINGHAMTON Secretary-Treasurer, Austin Fletcher, 406 Conklin Ave., Binghamton, N. Y.

BOSTON meets at the Hotel Statler, Boston, Mass., first Thursday each month. Secretary, A. W. Garrett, 77 Neponset Ave., Dorchester, Mass.

BRIDGEPORT meets first Friday of each month at Chamber of Commerce Rooms, Stratfield Hotel, Secretary-Treasurer, Joseph G. Sterling, 134 Colony St., Bridgeport, Conn.

BUFFALO meets second Friday of each month at Hotel Statler, Buffalo, N. Y. Secretary, J. P. Mays, c/o Carborundum Co., Niagara Falls, N. Y.

CHICAGO meets second Friday of each month at 8 p.m., Atlantic Hotel, 316 S. Clark St. Secretary, J. W. Hanlon, 3004 N. Whipple St., Chicago, Ill.

CINCINNATI meets on Fourth Thursday of each month at 8 p.m., at Hotel Gibson, Cincinnati, Ohio. Secretary, Alcide E. Foreman, Rt. 9, Van Zandt Road, Box 313, Cincinnati, Ohio.

CLEVELAND meets first Saturday of each month at Cleveland Hotel. Secretary-Treasurer, G. B. Svenson, c/o Plater Supply, 2059 Hamilton Ave., Cleveland, Ohio.

DAYTON meets second Friday of each month at the Engineers Club, Dayton, Ohio. Secretary-Treasurer, W. M. Durnbaugh, R. R. 4 Xenia, Ohio.

DETROIT meets the first Friday of each month at the Hotel Statler. Acting Secretary-Treasurer, Wright M. Wilson, 1570 Anita Ave., Grosse Point Woods, Mich.

GRAND RAPIDS meets second Friday of each month, 7:30 p.m., at the Browning Hotel. Secretary-Treasurer, C. E. Abel, 11 Scribner Ave., N.W., Grand Rapids, Mich.

HARTFORD meets third Monday of each month alternately at Hartford Electric Light Company, Hartford and at the Elks Club, corner South and Main Sts., Bristol, Conn. Special meetings are held at the New Britain Trade School, New Britain, Conn. Secretary-Treasurer, Kenneth Bellinger, 16 Mountain View Drive, Newington, Conn.

INDIANAPOLIS meets at the Hotel Riley, the first Wednesday of each month. Secretary-Treasurer, W. W. Cothran, 5242 Boulevard Place, Indianapolis, Ind.

LANCASTER meets second Friday of each month at 8 p.m., at Thaddeus Stevens Industrial School, Lancaster, Pa. Secretary-Treasurer, W. H. Fordney, 608 Marietta Ave., Lancaster, Pa.

LOS ANGELES meets second Wednesday of each month at 6:30 p.m., at the Elks Club, 607 S. Parkview, Los Angeles. Secretary-Treasurer, C. C. McLaren, 2236 Charnwood, Los Angeles, Calif.

MILWAUKEE meets first Friday of each month at Republican Hotel. Secretary-Treasurer, James Durnford, 2552 N. Weil St., Milwaukee, Wis.

MONTREAL meets first Monday of each month at Mount Royal Hotel, Montreal, Quebec, Canada. Secretary-Treasurer, Eugene Feeley, 8271 Foucher St., Montreal, Quebec.

NEWARK meets first and third Friday of each month at Hotel Robert Treat, Newark, N. J., at 8 p.m. Secretary-Treasurer, George Wagner, 1130 So. Long Ave., Hillside, N. J.

NEW HAVEN meets the first Tuesday of each month at Sterling Chemistry Laboratory, Yale University. Secretary-Treasurer, Walter Lynch, 110 Peck St., New Haven, Conn.

NEW YORK meets second and fourth Fridays of each month, in the Hotel Pennsylvania, 7th Ave. and 33rd St., New York City, N. Y. Secretary-Treasurer, Franklyn MacStoker, 25 Princeton St., Garden City, L. I., N. Y.

PHILADELPHIA meets fourth Friday of each month, in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts. No regular meeting in Nov., will meet Dec. 11th. Secretary, Paul Mentzer, 408 Princeton Ave., Philadelphia, Pa.

PITTSBURGH meets first Thursday of each month, at 8 p.m. at the Bureau of Mines Building, 4800 Forbes St., Pittsburgh, Pa. Secretary-Treasurer, Frank Keller, 1102 Hiland Ave., Coraopolis, Pa.

PROVIDENCE-ATTLEBORO meets at the Providence Biltmore Hotel the third Monday of each month. Secretary-Treasurer, Frederick E. Allen, 260 Fair Street, Edgewood Station, R. I.

ROCHESTER meets third Friday of each month at the Hotel Seneca. Secretary-Treasurer, Donald C. Blum, 672 Mt. Read Blvd., Rochester, N. Y.

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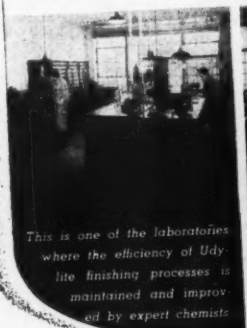

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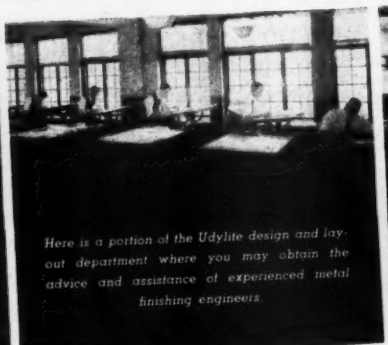

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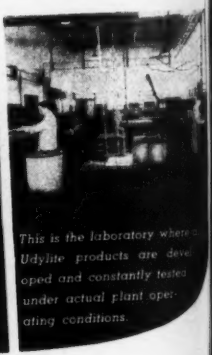

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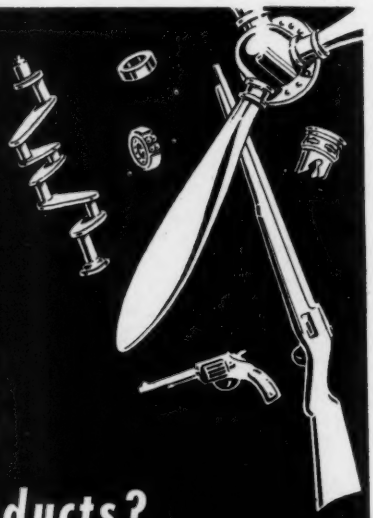

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